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NAVORD REPORT 1488 (Vol. 4)

HANDBOOK OF SUPERSONIC AERODYNAMICS

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NAVORD REPORT 1488 (Vol 4)
CHANGE 1

To all holders of NAVORD REPORT 1488 (Vol 4) insert change; write on cover 'Change 1 inserted'
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ASSISTANT DIRECTOR, RESEARCH AND DEVELOPMENT DIVISION

Pages ________ Page 1

NAVORD REPORT 1488 (Vol 4) HANDBOOK OF SUPERSONIC AERODYNAMICS
is changed as follows:

1. Insert this Change Sheet in the front of Volume 4.

2. On the pages indicated, make the following changes:

(a) Page 1201-5, Paragraph (c), Line 1
Insert the Greek letter Ω between "of" and "that".

(b) Page 1201-6, Paragraph (1), Line 3
Change the last word to "flutter".

(c) Page 1204.1-2, Line 8
Insert the bar over the right-hand side of the equation so as to make the equation read:

$$\zeta = \overline{(C_1^{\,2} - 4\ C_2)}$$

(d) Page 1204.11-1, Paragraph (a), Line 2
Insert the Greek Letter Ω between "parameter" and "and".

(e) Page 1204.11-2, Paragraph 2, Line 2
Change 0.7 to 2.0.

(f) Page 1204.11-2, Paragraph 3, Line 4, Eq. 1204.11-4
In the equation for $C_{L\alpha}$ change the second minus sign (-) to a plus sign (+), so as to read $C_{L\alpha} = -132.93679 + i\ 6.776163$.

(g) Page 1204.11-3, Equations 1204.11-9
In the equation for $4\ C_2$ change 8.4258 to 8.4260.
In the equations for $C_1^{\,2} - 4\ C_2$ and for ζ change 1.0735 to 1.0734.
In the equation for θ, change $-29°2.74'$ to $-29°2.9'$.

(h) Page 1204.11-4, Paragraph 3, first sentence
Change this sentence to read "Similar computations of $\omega_\alpha b/a$ (the reduced natural frequency k_α), and of g, have been completed for sixteen values of Ω, ranging from 0.2 to 2.0, and all of these values have been plotted (g vs k_α) in Figure 1204.11-1 for Mach number 1.4."

(i) Page 1204.11-5 (Figure 1204.11-1)

Change "g_α" to "g" in the ordinate designation; and add as legend in lower right-hand corner of grid:

$$g_\lambda = g_\alpha \equiv g$$

$$m/\pi\rho b^2 = 100.0$$

$$I'_\alpha/\pi\rho b^4 = 16.67$$

$$\omega_h/\omega_\alpha = 0.700$$

$$r = 0$$

$$x_\alpha = 0$$

(j) Page 1206-2, Equation 1206-4

In the equation for A_{31}, change the exponent in the third term from 4 to 3 so as to make this equation read:

$$A_{31} = C_{Lh}\left(\frac{1}{2} + c\right) - C_{Mh} - \left(\frac{1+c}{2}\right)^3 \left(\frac{3}{2} C''_{Lh} - C''_{Mh}\right)$$

In the equation for A_{32}, change the coefficients of the last two terms in the bracketed [ ] expression from $C''_{L\alpha}$ to C''_{Mh} and from C''_{Lh} to $C''_{L\alpha}$ respectively, so as to make the bracketed expression read:

$$\left[- C''_{M\alpha} - \frac{3}{2} C''_{Lh}\left(2\,\frac{r+1}{c+1} - \frac{1}{2}\right) + C''_{Mh}\left(2\,\frac{r+1}{c+1} - \frac{1}{2}\right) + \frac{3}{2} C''_{L\alpha}\right]$$

NAVORD REPORT 1488 (Vol. 4)

HANDBOOK OF SUPERSONIC AERODYNAMICS

Compiled and edited under Bureau of Ordnance Contract NOrd 7386 by the Aerodynamics Handbook Staff of The Johns Hopkins University, Applied Physics Laboratory, Silver Spring, Maryland. The selection and technical editing of the material appearing in the Handbook are functions of a Reviewing Committee appointed by the Director of the Laboratory. The membership of this Committee is presently as follows: C. N. Warfield (Chairman), L. L. Cronvich, A. R. Eaton, Jr., G. M. Edelman, and F. K. Hill.

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HANDBOOK OF SUPERSONIC AERODYNAMICS

Volume 4

Preface

A general preface to the entire Handbook of Supersonic Aerodynamics appears in Volume 1; therefore, the present preface applies specifically to the present issue of this portion of Volume 4 only.

This volume, when completed, will contain the following sections: Section 9 - Mutual Interference Phenomena, Section 10 - Static Stability, Section 11 - Dynamic Stability, and Section 12 - Aeroelastic Phenomena. Section 12 only is being issued at this time; the remaining sections for Volume 4 will be issued when completed.

Since the publication of Volumes 1 and 2 the contents of future volumes in the Handbook Series has been changed in accordance with the outline set forth on page iii of this preface under the caption: "Contents of Future Volumes in the Handbook of Supersonic Aerodynamics Series."

The numbering system for Volume 4 is the same as that used in Volume 2.

Agencies and individuals interested in the aeronautical sciences should feel free to submit and recommend material for inclusion in the Handbook; full credit will be given for all such material used. In the selection of material and the preparation of the volumes in the Handbook Series, the Applied Physics Laboratory lays claim neither to omniscience nor to infallibility; therefore, it earnestly solicits constructive criticisms and suggestions. Correspondence relating to the editing of the Handbook Series should be sent to

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ABBREVIATED TABLE OF CONTENTS FOR PUBLISHED SECTIONS (arranged by volumes) OF THE HANDBOOK OF SUPERSONIC AERODYNAMICS SERIES

VOLUME 1* (NAVORD REPORT 1488, Unclassified)

Section 1 - Symbols and Nomenclature
Section 2 - Fundamental Equations and Formulae
Section 3 - General Atmospheric Data
Section 4 - The Mechanics and Thermodynamics of Steady One-Dimensional Gas Flow

VOLUME 2* (NAVORD REPORT 1488, Unclassified)

Section 5 - Compressible Flow Tables and Graphs

VOLUME 4* (NAVORD REPORT 1488, Unclassified)

Section 12 - Aeroelastic Phenomena

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Volume 4 (Section 12) (NAVORD REPORT 1488)........$1.25 per copy

CONTENTS OF FUTURE VOLUMES IN THE HANDBOOK OF SUPERSONIC AERODYNAMICS SERIES

VOLUME 3

Section 6 - Two-Dimensional Airfoils
Section 7 - Three-Dimensional Airfoils
Section 8 - Solid and Ducted Bodies

VOLUME 4

Section 9 - Mutual Interference Phenomena
Section 10 - Static Stability
Section 11 - Dynamic Stability
Section 12* - Aeroelastic Phenomena

VOLUME 5

Section 13 - Viscosity Effects
Section 14 - Heat Transfer
Section 15 - Properties of Gases
Section 16 - Mechanics of Rarefied Gases

VOLUME 6

Section 17 - Ducts, Nozzles and Diffusers
Section 18 - Free Jets
Section 19 - Wind Tunnel Design and Instrumentation
Section 20 - Measurement Techniques
Section 21 - Miscellaneous Problems

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* Published herewith.

SECTION 12 - AEROELASTIC PHENOMENA

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SECTION 12 - AEROELASTIC PHENOMENA

The following symbols are used in the material appearing on pages 1200-1 to 1208.2-58 of Section 12:

Primary Symbols

a	velocity of sound (free stream), ft/sec
b	semi-chord length, ft
c	location of aileron hinge line measured from mid-chord point in fractions of the semi-chord (+ aft)
C_h	translational spring constant per unit span, (lbs/ft) / (ft span)
C_1, C_2, C_3	coefficients of determinantal equation
C_{Lh}	part of supersonic flutter aerodynamic force coefficient due to vertical displacement of the wing quarter-chord axis only
$C_{L\alpha}$	part of supersonic flutter aerodynamic force coefficient due to rotational motion only
C_{Mh}	part of supersonic flutter aerodynamic moment coefficient due to vertical displacement of the wing quarter-chord axis only
$C_{M\alpha}$	part of supersonic flutter aerodynamic moment coefficient due to rotational motion only
C'_{Lh}	C_{Lh} when using the reduced frequency of the aileron
$C'_{L\alpha}$	$C_{L\alpha}$ when using the reduced frequency of the aileron
C'_{Mh}	C_{Mh} when using the reduced frequency of the aileron
$C'_{M\alpha}$	$C_{M\alpha}$ when using the reduced frequency of the aileron
C''_{Lh}	C_{Lh} when using the reduced frequency of the wing forward of the aileron
$C''_{L\alpha}$	$C_{L\alpha}$ when using the reduced frequency of the wing forward of the aileron
C''_{Mh}	C_{Mh} when using the reduced frequency of the wing forward of the aileron
$C''_{M\alpha}$	$C_{M\alpha}$ when using the reduced frequency of the wing forward of the aileron
C_α	torsional spring constant per unit span, (ft-lbs/rad)/(ft span)

C_β	torsional spring constant per unit span for aileron (ft-lbs/rad)/(ft span)
d	distance of elastic axis aft of quarter-chord line, ft
E	Young's modulus of elasticity
E_e	elastic energy
E_k	kinetic energy
F	half the rate of energy dissipation
g_h	structural translational damping factor
g_α	structural torsional damping factor
g_β	structural torsional damping factor for aileron
G	shear modulus of elasticity
h	displacement of wing quarter-chord axis from the neutral position (+ downward), ft; also a generalized displacement
h'	displacement of wing elastic axis from the neutral position (+ downward), ft
h_o	amplitude of h; also generalized amplitude of displacement
h'_o	amplitude of h'
i	complex operator, $\sqrt{-1}$
I	section moment of inertia, ft^4
I'_α	moment of inertia of system about elastic axis per unit span, $lb\text{-}ft\text{-}sec^2$/(ft span)
I_β	moment of inertia of aileron about hinge line per unit span, $lb\text{-}ft\text{-}sec^2$/(ft span)
J	effective section polar moment of inertia, ft^4
k	reduced frequency, $\omega b/V$, non-dimensional $\left[= \Omega \ (M^2-1)/2M^2\right]$
k_α	reduced natural frequency in torsion, ω_α b/a
ℓ	semi-span, ft
L	aerodynamic force per unit span, assumed at quarter-chord (+ downward, negative lift)#

#The symbol L for aerodynamic force, as used in this section of the Handbook, for either primary or secondary concepts, is in the opposite direction to that of lift as customarily used in aerodynamics and as defined in Section 1 of this Handbook.

L_g	generalized aerodynamic force
L_h	part of aerodynamic force per unit span (L), assumed at quarter-chord point, due to various time derivatives of vertical displacement (h) of the wing quarter-chord axis
L_α	part of aerodynamic force per unit span (L), assumed at quarter-chord point, due to rotational displacement of the wing
L_β	aerodynamic force due to aileron per unit span
m	mass of moving system per unit span
m_1	mass of wing per unit span (m_1 = m in most applications)
m_β	mass of aileron per unit span
M	Mach number (free stream), V/a; also moment per unit span (+ nose up)
M_g	generalized aerodynamic moment per unit span about elastic axis
M_h	part of aerodynamic moment per unit span (M) about the quarter-chord axis, due to vertical displacement (h) of the wing
M_α	part of aerodynamic moment per unit span (M) about the quarter-chord axis, due to rotational displacement of the wing
M_β	aerodynamic moment about hinge line due to the aileron
M'	aerodynamic moment per unit span, about the elastic axis
N	mechanical parameter, $I'_\alpha / \pi\rho b^4$, non-dimensional
r	location of wing elastic axis measured from wing mid-chord point as a fraction of the semi-chord (+ aft), non-dimensional
S	mass unbalance per unit span, $mx_\alpha b$
t	time, seconds
V	air velocity (free stream), ft/sec
x_α	distance of center of gravity chordwise from elastic axis as a fraction of the semi-chord (+ aft), non-dimensional
x_β	distance of center of gravity of aileron, measured from aileron hinge line, in fraction of the semi-chord (+ aft)
y	distance along span from wing root
α	displacement of wing in rotation from the neutral position, radians/(ft span), (+ nose up)

α_o	displacement of wing in rotation from the neutral position, normalized in three-dimensional case, per unit span, radians
β	angle of aileron with respect to chord line of wing (+ trailing edge downward)
$\Delta_o, \Delta_1, \Delta_2, \Delta_3$	coefficients in the third order stability equation (see Subsection 1207)
ρ	air density
μ	Mach angle = arc sin 1/M $\left[\therefore \cos^2 \mu = (M^2 - 1)/M^2\right]$
ϕ_1, ϕ_2, ϕ_3	functions of y defining the shapes of vibration modes
ω	circular frequency of oscillation, radians/sec
ω_h	uncoupled natural frequency in translation, $\sqrt{C_h/m}$, radians/sec
ω_α	uncoupled natural frequency in torsion, $\sqrt{C_\alpha/I'_\alpha}$, radians/sec
ω_β	uncoupled natural frequency in torsion of aileron, $\sqrt{C_\beta/I_\beta}$, radians/sec
Ω	frequency parameter, $= 2k/\cos^2 \mu = \left[2M^2/(M^2 - 1)\right] k$

Auxiliary Symbols

The bar over a symbol ($\bar{\ }$) denotes the real component of the complex quantity designated by the associated symbol.

The asterisk (*), used as a superscript, denotes the imaginary component of the complex quantity designated by the associated symbol.

The dot ($\dot{\ }$) is used to denote differentiation with respect to time, thus $\dot{\alpha} = d\alpha/dt$ and $\ddot{\alpha} = d^2\alpha/dt^2$.

SECTION 12 - AEROELASTIC PHENOMENA

This section of the Handbook of Supersonic Aerodynamics was prepared at the Applied Physics Laboratory of The Johns Hopkins University, with the cooperation of the Bumblebee Committee on Aeroelasticity and Structural Dynamics. Members of this committee were as follows:

M. V. Barton	-	Defense Research Laboratory, University of Texas
C. W. Besserer	-	Applied Physics Laboratory, The Johns Hopkins University - Chairman
H. A. Cheilek	-	Cornell Aeronautical Laboratory
M. Dublin	-	Consolidated Vultee Aircraft Corporation
A. H. Flax	-	Cornell Aeronautical Laboratory
H. W. Pope	-	Consolidated Vultee Aircraft Corporation
T. K. Riggs*	-	Applied Physics Laboratory, The Johns Hopkins University - Secretary

The original draft of this section was prepared for the Committee by T. K. Riggs in accordance with the Committee's recommendations and suggestions. The final draft was prepared by C. N. Warfield who gratefully acknowledges the helpful comments and suggestions by the members of the Committee and by his colleagues, F. K. Hill, J. P. Kearns, R. M. Mains, and E. Shotland--and the helpful assistance of Mrs. Corine Carwile Bloss who checked many of the equations and the numerical results, computed the numerical example, and prepared the copy for the final graphs.

The tables of flutter coefficients which appear in this section were especially computed, under the supervision of E. C. Kennedy, at the Ordnance Aerophysics Laboratory on International Business Machines Corporation equipment for initial publication in this Handbook.

1200 Introduction

1200.1 General Scope of Section

In this section of the Handbook there are presented certain tables and graphs that may be used, on the basis of flutter considerations, in the design of guided missiles. In addition there is included here a brief treatment of certain theoretical aspects of flutter in the supersonic regime. This treatment includes a derivation of one of the equations for flutter of airfoils in supersonic flow, namely that for torsional flutter of a two-dimensional (infinite) wing.

The tables above referred to (Tables 1208.2) contain the real and imaginary parts of the supersonic force and moment flutter coefficients for airfoils. These flutter coefficients are equivalent to those originally defined by Borbely (Reference 12-1).

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* Presently employed by Engineering Research Associates, Inc.

These tables were computed by use of a recursion formula that was devised by E. C. Kennedy, and they are tabulated as a function of a frequency parameter (Ω) for each of several values of Mach number (M). The parameter (Ω) is related to the reduced frequency (k) and to the Mach number (M) by the equation $\Omega = \left[2M^2/(M^2 - 1)\right]k$, and a table based on this relationship is presented (Table 1208.1). The reduced frequency is the ratio between the circular frequency of oscillation (ω), in radians per second, and the number of times per second that the wing, due to its forward speed (V), traverses a distance equal to its semi-chord (b).

The tabular values for the flutter coefficients in the great majority of cases are believed to be accurate to within one in the last digit, and in no case is the tabulated value in error by more than two in the last digit. The Mach number range covered is from 1.1 to 12 while the value of Ω ranges from 0.01 to 20. The increments in both M and Ω are in general smaller than in existing similar tables. Because supersonic flutter computations sometimes involve relatively small differences of coefficients, these coefficients have been computed and tabulated in most cases to eight significant figures, although in many applications three or four digits will suffice.

Also included in this section are brief treatments of binary flutter (wing torsion and bending modes) and of ternary flutter (wing torsion, first- and second-bending modes, aileron and wing torsion and bending modes). Both two-dimensional (infinite span) and three-dimensional (finite span) airfoils are analyzed. Brief discussions are given of certain methods of solution for the higher order determinantal equations that appear in some of these analyses. A brief mention of the use of coupled and of uncoupled vibration modes in supersonic flutter is included.

For the purpose of familiarizing the non-specialist with the technique of flutter computations, this section includes a numerical example of an application of the supersonic flutter coefficients. This example is for two-dimensional binary flutter, and is based on the method presented in the Air Materiel Center report entitled "Application of Three-Dimensional Flutter Theory to Aircraft Structures" (Reference 12-2).

In addition to the list of cited references, there is included at the end of this subsection a bibliography of the more pertinent literature on supersonic flutter.

The effects of body motion and the flexibility of attachment of the wing are not discussed in this section since these effects are adequately covered in the literature on subsonic flutter (Reference 12-2). Finite span effects, resulting in a loss of lift force at the wing tip, are not taken into account; however, theoretical studies are available on this subject (References 12-3, 12-4, 12-5, 12-6 and 12-7). Empirical corrections may be used to account for tip effects with some degree of reliability.

The effect of sweepback on the fluctuating aerodynamic forces is somewhat more complicated than the effect on the static lift and moment coefficients for the same type of wing. These sweepback effects are discussed in Reference 12-3. It is possible to calculate the effects of sweepback on the elastic properties of a wing by the use of approximations, provided the aspect ratio is sufficiently high. Whenever a completed structure is available its elastic properties may be obtained from ground vibration tests.

1200.2 Basic Concepts

An airframe at rest on the ground in still air will respond to an impulse in one of three ways. Depending upon the amount of structural damping present it will either execute a series of periodic oscillations of diminishing amplitude, or return to its initial state of rest in the shortest possible time (critically damped), or return more slowly to a state of rest.

If the airframe at rest is subjected to a sinusoidal forcing function it will, after passing through a transient condition, settle into a steady-state vibratory motion with a frequency the same as that of the forcing function, and whose deflections and amplitude of vibration are determined by the applied frequency, as well as by the elastic, inertial, and damping characteristics of the airframe structure.

Since fluctuating aerodynamic forces result from oscillatory motions of an airframe, the response of an airframe to an impulse or sinusoidal forcing function will be determined by these fluctuating aerodynamic forces as well as by the characteristics of the airframe structure. If the phase relationship of the aerodynamic forces is such as to reinforce the motions producing them, then a condition of self-sustaining oscillation is possible. This condition gives rise to what is known as flutter. The flutter frequency is determined by the flight Mach number as well as by the structural characteristics of the airframe.

In flutter analyses computations are made for the critical flutter condition in which the amplitude of vibration tends to remain constant. When the amplitude of vibration increases the condition is considered unsafe; when the amplitude decreases it is considered safe.

The boundary between the safe and unsafe flutter conditions may be identified by investigating the equations of motion. An approximate measure of the margin of safety may be given by the value of the critical structural damping factor computed for the airfoil structure with the aid of the herein tabulated aerodynamic flutter coefficients. Then this value can be compared with the actual structural damping factor obtained experimentally by a vibration test, or by estimation based on experience. Or, the degree of safety from flutter may be estimated by considering the distance between the point on a suitable chart describing the known properties of the wing and the line on the same chart, based on the herein tabulated flutter coefficients, which designates the boundary between the "safe" and "unsafe" regions.

In flutter analyses the computations are based on the frequency, shape and phase relationship of certain vibration modes that are characteristic of the structure. Ideally, the principal* modes as they occur in flight under the aerodynamic conditions that exist during critical flutter oscillations would be used in these flutter analyses. Theoretically, in the case of three-dimensional bodies, there are an infinite number of possible vibration modes. For practical purposes, however, the deformation of an airframe during a state of critical flutter may be assumed to be a combination of the deflections due to the first two, three, or possibly four of the principal modes of vibration--these principal modes correspond to the lower frequencies at which the structure vibrates in resonance. Approximations to these desired modes may be obtained by analytical methods, or by measurements made on the airframe while vibrating either at rest on the ground in still air, or while in flight, or by other experimental means. Reference 12-8 demonstrates the feasibility of basing the analyses upon the actual coupled modes of vibration rather than upon the fictional uncoupled modes.

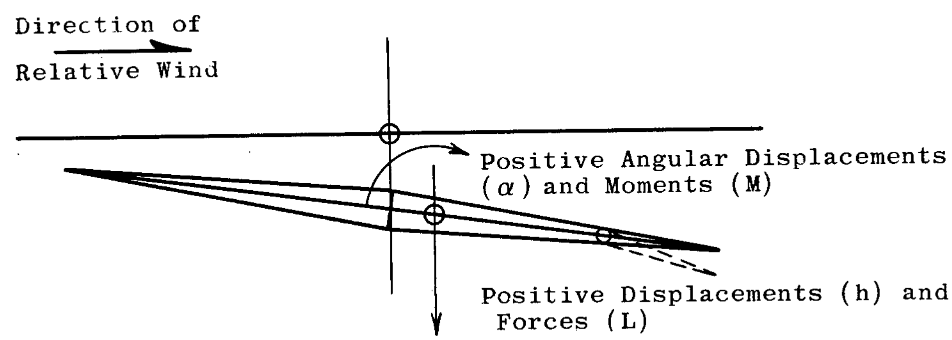
* Sometimes referred to in the literature on flutter as the characteristic, natural, or normal (coupled) modes.

It has been found that flutter may occur in the torsional mode without the presence of a flexure component. This is because at certain frequencies and elastic axis positions the aerodynamic damping is negative, that is, the imaginary component of the aerodynamic moment acts in phase with the angular velocity so as to accelerate the wing in rotation rather than retard it. However, it has been shown that such pure torsional flutter cannot occur at Mach numbers greater than 1.58 (Reference 12-9) for slow oscillations, and the limiting Mach numbers for more rapid oscillations do not differ much from this slow oscillation value.

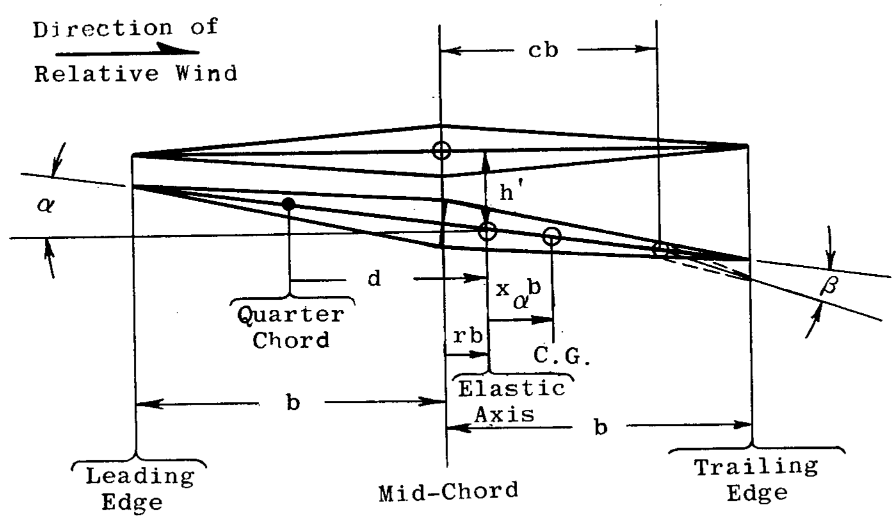
If an unswept wing were to oscillate in bending only, with no rotary motion, then the aerodynamic damping would always be positive, and no flutter involving this mode alone will occur.

1201 Two-Dimensional Torsional Flutter

When an airfoil oscillates in a torsional mode only, various moments about the axis of rotation are involved. For a unit span of the airfoil the elastic restoring moment will be $-C_{\alpha}\alpha$ (cf. symbols list on pages 1200-1 and 1200-3, and Figure 1201-1), and the structural damping moment is represented as a fraction, g_{α}, of the elastic restoring moment, rotated in



a. Directions (The notation as to directions is the same as that of the NACA and the American Standards Association's "Letter Symbols for Aeronautical Sciences, Z-10.7, 1950")



b. Symbols

Figure 1201-1 TWO-DIMENSIONAL WING NOTATIONS

984042 O - 52 - 2

phase so as to lead the latter by 90 degrees. The resultant of these two moments may be represented by $-(1 + i\, g_\alpha) C_\alpha \alpha$, where i is the complex operator $\sqrt{-1}$. The inertial moment per unit span is expressed by $-I'_\alpha \ddot{\alpha}'$ and the aerodynamic moment per unit span about the elastic axis is represented here as M'. The sum of these moments is zero, and consequently the aerodynamic moment may be expressed by

$$M' = I'_\alpha \ddot{\alpha} + (1 + ig_\alpha) C_\alpha \alpha \qquad (1201\text{-}1)$$

Consider now the contribution to the aerodynamic moment M' about the elastic axis per unit span due to the rotational displacement α of the wing from the neutral position. If we let the positive aerodynamic force (that is, negative lift L_α), due to this angular displacement, act at a distance d forward of the elastic axis, and let M_α represent the aerodynamic pitching moment about the line passing through the point of application of the aerodynamic force L_α, it is obvious that such a rotational displacement contributes to the moment about the elastic axis an amount (see Figure 1201-2)

$$M_\alpha - L_\alpha d$$

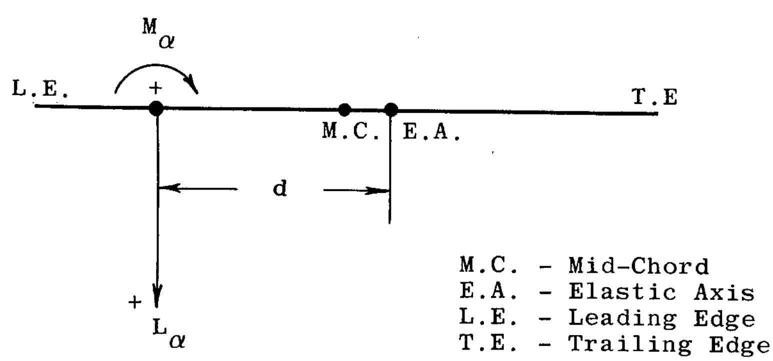


Figure 1201-2 FORCE AND MOMENT NOTATIONS

Likewise, in view of the effect of various time derivatives of displacement (h) of the wing quarter-chord axis which contribute M_h and L_h relative to the quarter-chord, it similarly follows that such a translatory displacement contributes to the moment about the elastic axis an amount

$$M_h - L_h d$$

The total aerodynamic moment about the elastic axis, due to both rotational and translatory motions, is therefore

$$M' = (M_\alpha - L_\alpha d) + (M_h - L_h d) \qquad (1201\text{-}2)$$

Using aerodynamic force and moment flutter coefficients that are defined by

$$C_{Lh} = \frac{L_h}{\pi \rho b^2 \omega^2 h}$$

$$C_{L\alpha} = \frac{L_\alpha}{\pi \rho b^3 \omega^2 \alpha}$$

$$C_{Mh} = \frac{M_h}{\pi \rho b^3 \omega^2 h} \qquad (1201\text{-}3)$$

$$C_{M\alpha} = \frac{M_\alpha}{\pi \rho b^4 \omega^2 \alpha}$$

one finds that Equation 1201-2 becomes

$$M' = \pi \rho b^4 \omega^2 \left[C_{M\alpha}\alpha - C_{L\alpha} \frac{d}{b} \alpha + C_{Mh} \frac{h}{b} - C_{Lh} \frac{hd}{b^2} \right] \qquad (1201\text{-}4)$$

If, as is customary in subsonic flutter analyses, we assume the lift force to act at the quarter-chord point then

$$d = b \left(\frac{1}{2} + r\right)$$

and we find that Equation 1201-4 becomes

$$M' = \pi \rho b^4 \omega^2 \left[C_{M\alpha}\alpha - C_{L\alpha} \left(\frac{1}{2} + r\right) \alpha + C_{Mh} \left(\frac{1}{2} + r\right) \frac{h}{d} - C_{Lh} \left(\frac{1}{2} + r\right)^2 \frac{h}{d} \right] \qquad (1201\text{-}5)$$

(Note- This equation for two-dimensional flutter could have been obtained directly from the Borbely-Possio equation (1203-8) by using the relation $h' = h + \alpha d$; cf. Figure 1201-3.)

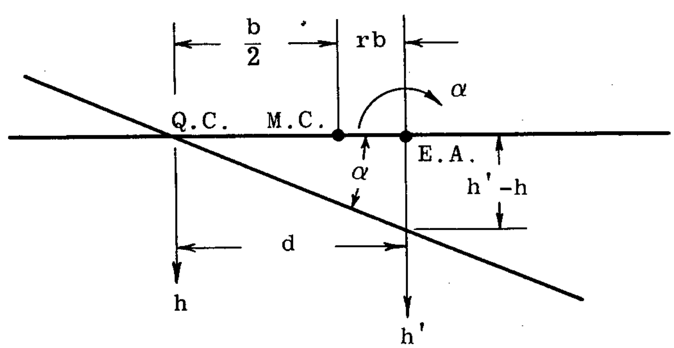


Figure 1201-3 DISPLACEMENT NOTATIONS

To transform the motion parameters from the quarter-chord axis to the elastic axis (see Figure 1201-3), let

$$h' = h + \alpha d \tag{1201-6}$$

For the torsional mode only $h' = 0$; and therefore Equation 1201-6 reduces to

$$\frac{h}{d} = -\alpha \tag{1201-7}$$

Equation 1201-5 then becomes

$$M' = \pi\rho b^4\omega^2\alpha\left[C_{M\alpha} - C_{L\alpha}\left(\frac{1}{2} + r\right) - C_{Mh}\left(\frac{1}{2} + r\right) + C_{Lh}\left(\frac{1}{2} + r\right)^2\right] \tag{1201-8}$$

For harmonic oscillatory motion of rotation, we may write

$$\alpha = \alpha_o e^{i\omega t} \tag{1201-9}$$

Differentiating α (Equation 1201-9) twice with respect to time, and substituting α and its second time derivative, and Equation 1201-8 into Equation 1201-1, and substituting ω_α^2 for C_α / I'_α, one obtains

$$\left(\frac{\omega_\alpha}{\omega}\right)^2(1 + ig_\alpha) - 1 + \frac{\pi\rho b^4}{I'_\alpha}\left[-C_{M\alpha} - C_{Lh}\left(\frac{1}{2} + r\right)^2 + C_{L\alpha}\left(\frac{1}{2} + r\right) + C_{Mh}\left(\frac{1}{2} + r\right)\right] = 0 \tag{1201-10}$$

(Note- This equation for two-dimensional torsional flutter could have been obtained from the more general determinantal equation for two-dimensional binary flexure-torsion flutter (Equation 1202-9), by equating the $M_{22} + A_{22}$ element to zero, in which M_{22} and A_{22} are defined by Equations 1202-7 and 1202-10, respectively.)

For convenience, the real and imaginary parts of the aerodynamic coefficient term (i.e., the term included in the brackets) are represented hereafter by $\bar{A}_{22}$ and A^*_{22} respectively, whence

$$\bar{A}_{22} = -\bar{C}_{M\alpha} - \bar{C}_{Lh}\left(\frac{1}{2} + r\right)^2 + \bar{C}_{L\alpha}\left(\frac{1}{2} + r\right) + \bar{C}_{Mh}\left(\frac{1}{2} + r\right)$$

and (1201-11)

$$A^*_{22} = -C^*_{M\alpha} - C^*_{Lh}\left(\frac{1}{2} + r\right)^2 + C^*_{L\alpha}\left(\frac{1}{2} + r\right) + C^*_{Mh}\left(\frac{1}{2} + r\right)$$

The reason for the use of the subscript 22 will be apparent in the subsection on binary flutter, 1202. With this symbolism, Equation 1201-10 becomes

$$\left(\frac{\omega_\alpha}{\omega}\right)^2(1 + ig_\alpha) - 1 + \frac{\pi\rho b^4}{I'_\alpha}\left(\bar{A}_{22} + iA^*_{22}\right) = 0 \tag{1201-12}$$

Equation 1201-12 may be written as two equations: one including only the real terms, and the other only the imaginary terms. When this is done and the substitution $N = I'_\alpha/\pi\rho b^4$ is made, the following equations may be obtained:

$$\left(\frac{\omega_\alpha}{\omega}\right)^2 = 1 - \frac{\bar{A}_{22}}{N} \qquad (1201\text{-}13)$$

$$g_\alpha = \frac{-A^*_{22}}{N - \bar{A}_{22}} \qquad (1201\text{-}14)$$

These equations for two-dimensional torsional flutter may be used for a quick survey of the flutter characteristics of a finite wing if one first obtains an approximate spanwise average value for each of the parameters involved, e.g. I'_α, b, r and ω_α. However, the use of such spanwise average values in the equations for two-dimensional torsional flutter obviously cannot be relied upon for precise results.

When values of ω and M, and therefore also of $\bar{A}_{22}$ and A^*_{22} for a certain elastic axis location (r), are found which satisfy Equations 1201-13 and 1201-14, the conditions for borderline two-dimensional torsional flutter are defined for the conditions represented by the parameters $I'_\alpha/\pi\rho b^4$ and $\omega_\alpha b/a$. The latter term, $\omega_\alpha b/a$, is hereafter referred to as the "reduced natural frequency," k_α.

Several methods may be used to obtain significant data from these equations, two of which are described below.

Method 1. Computation of torsional damping factor g_α.

(a) At each Mach number of interest, using the mechanical parameter N and the elastic axis location r of the wing, determine by means of Equation 1201-13, for a series of values of the frequency parameter Ω, the corresponding values of ω_α/ω. Then the reduced natural frequency k_α can be determined by

$$k_\alpha = Mk\left(\frac{\omega_\alpha}{\omega}\right) \qquad (1201\text{-}15)$$

where k, the reduced frequency, is given by

$$k = \Omega\left(\frac{M^2-1}{2M^2}\right)$$

(b) Likewise, by means of Equation 1201-14, one can determine the values of g_α corresponding to the same values of Ω that were used in (a), for the same combination of values of M, r, and N.

(c) For each value of Ω that was used in parts (a) and (b) there has been obtained a pair of values of g_α and of k_α. These pairs of values can then be plotted as in Figures 1201-4a, b, c and d, which represent four combinations of fairly extreme values of r and of N. Of course, figures of this type can be prepared for any desired combination of values for r and N.

If the borderline damping factor g_α thus determined is negative or less positive than the actual structural torsional damping factor for the structure, as determined by damped vibration test data, safety from flutter is indicated; if it is positive and greater than the experimental value, unsafe flutter is indicated.

Method 2. Computation, assuming the torsional damping factor g_α is zero.

If one is interested in determining only a conservative indication of the flutter characteristic of the structure (that is, whether or not the structural parameters are such as to indicate no flutter even if the structural torsional damping factor g_α is zero), then it is necessary to determine from Equations 1201-13 and 1201-14 what combinations of the several parameters correspond to the conservative condition represented by $g_\alpha = 0$. This has been computed for various practical ranges of the several parameters and the results are given in Figures 1201-5. The dashed portions of these curves represent extrapolated values only. In these figures regions above the curves are free from flutter, but below these curves the likelihood of flutter occurring increases with increasing distances. For example, with a structure for which r=0, N=20 and $k_\alpha = 0.25$, it is evident that flutter is probable only at Mach numbers between 1.133 and 1.311.

Other methods of obtaining and presenting results for single-degree-of-freedom (torsional) flutter are described in References 12-10 and 12-11.

The following facts are important in making a decision as to whether or not an analysis for single-degree-of-freedom (torsional) flutter is adequate in any specific situation:

(1) For elastic axis positions close to the mid-chord, static divergence (when second-order shift in aerodynamic center location is taken into account) may be more critical than torsional ~~fultter~~ flutter.

(2) At low supersonic Mach numbers the flow may be transonic in character, and the applicability of linearized supersonic aerodynamic forces used in these analyses would then be in doubt.

(3) For $(\omega_h / \omega_\alpha) < 1$, the binary flutter stability boundary will usually be more critical than these torsional ones.

For binary flexure-torsion flutter an approximation can be obtained by the method described in Subsection 1202; and for actual finite wings more reliable results can be obtained by means of the equations for three-dimensional binary flexure-torsion flutter that are presented in Subsection 1203.

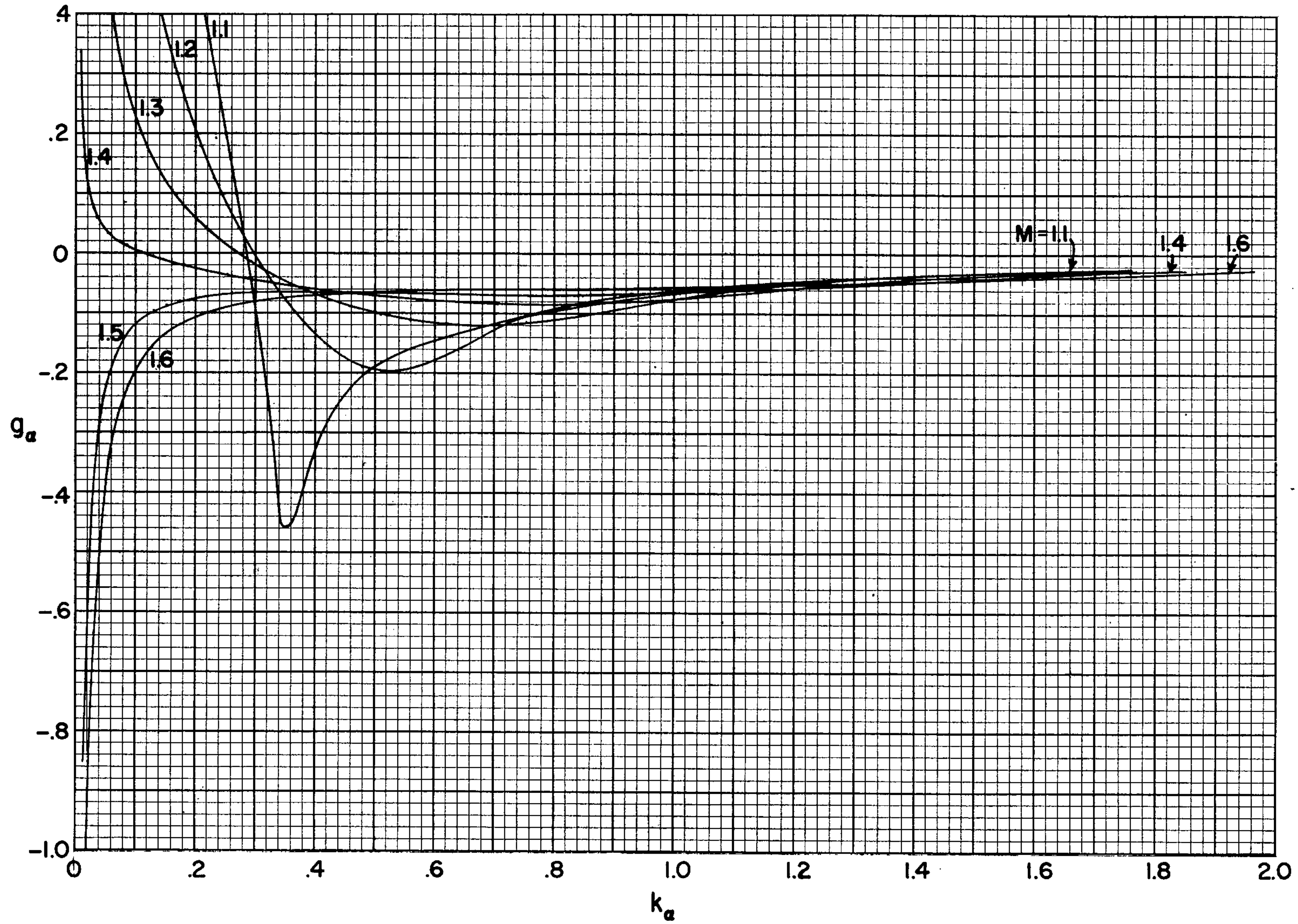


Figure 1201-4a STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER; g_α vs k_α, MACH NUMBER (M) INDEPENDENT. $r = 0$ and $N = 10$

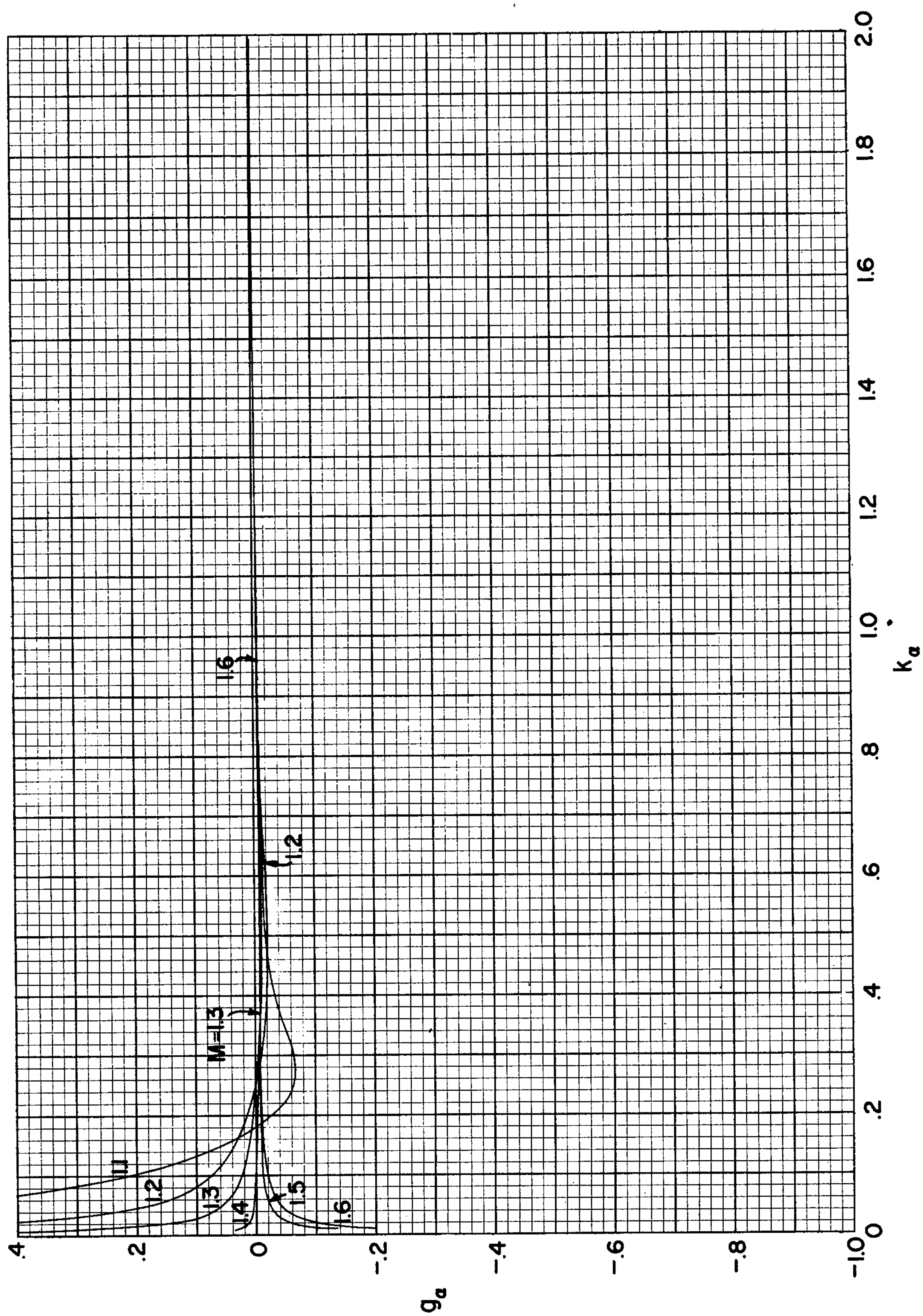


Figure 1201-4b STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER; g_α vs k_α, MACH NUMBER (M) INDEPENDENT. r = 0 and N = 100

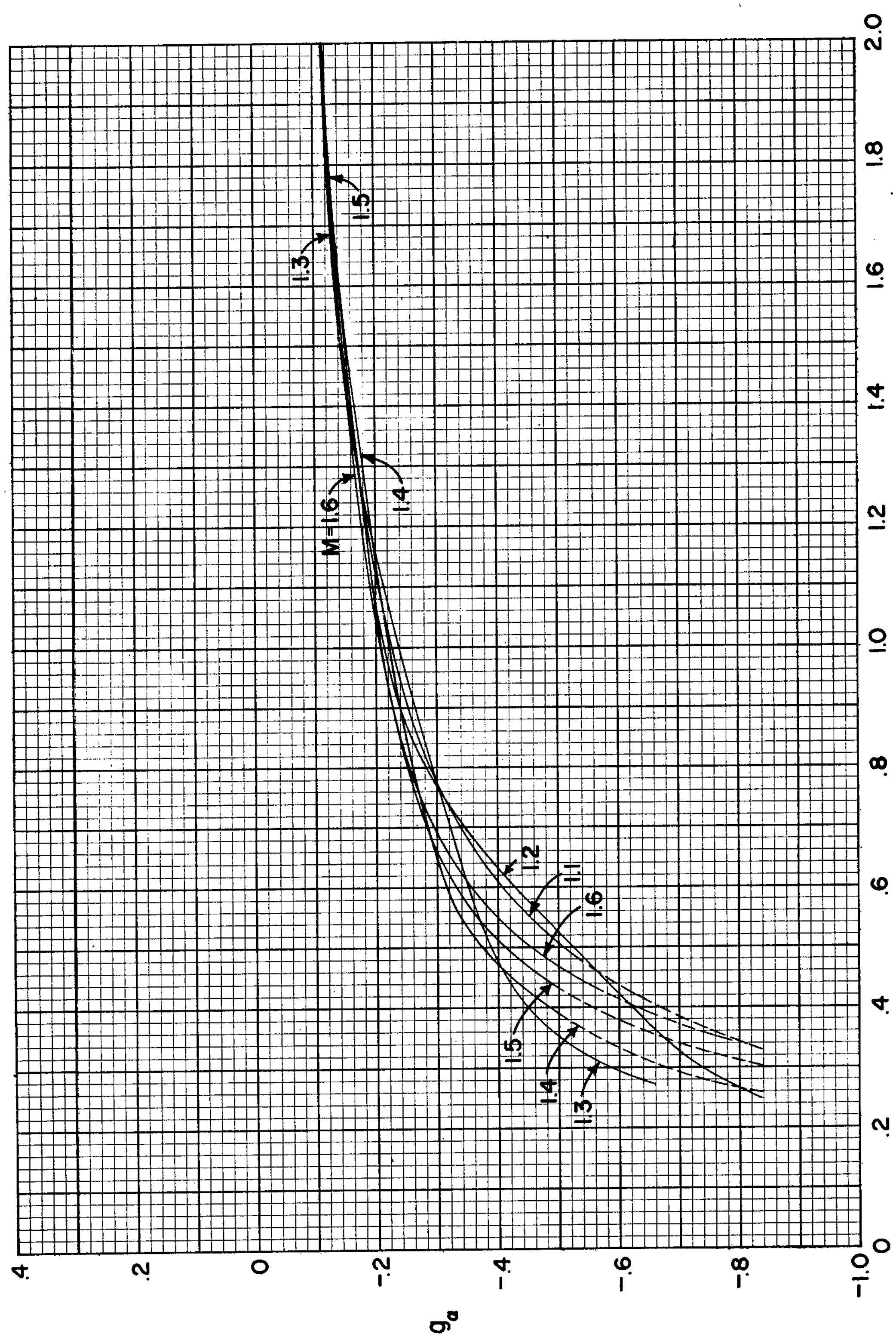


Figure 1201-4c STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER; g_α vs k_α, MACH NUMBER (M) INDEPENDENT. r = -1.2 and N = 10

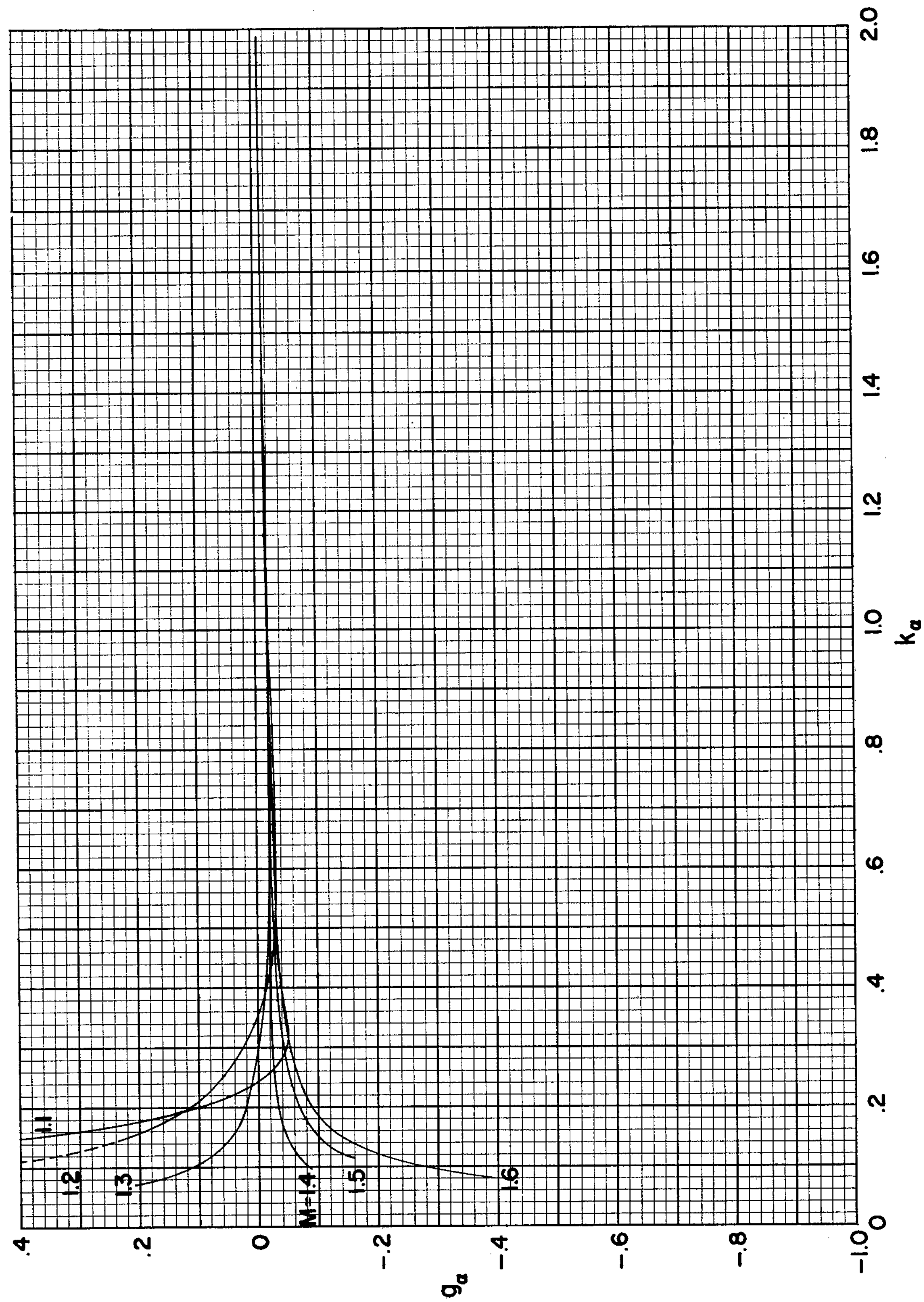


Figure 1201-4d. STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER; g_α vs k_α, MACH NUMBER (M) INDEPENDENT. r = -1.2 and N = 100

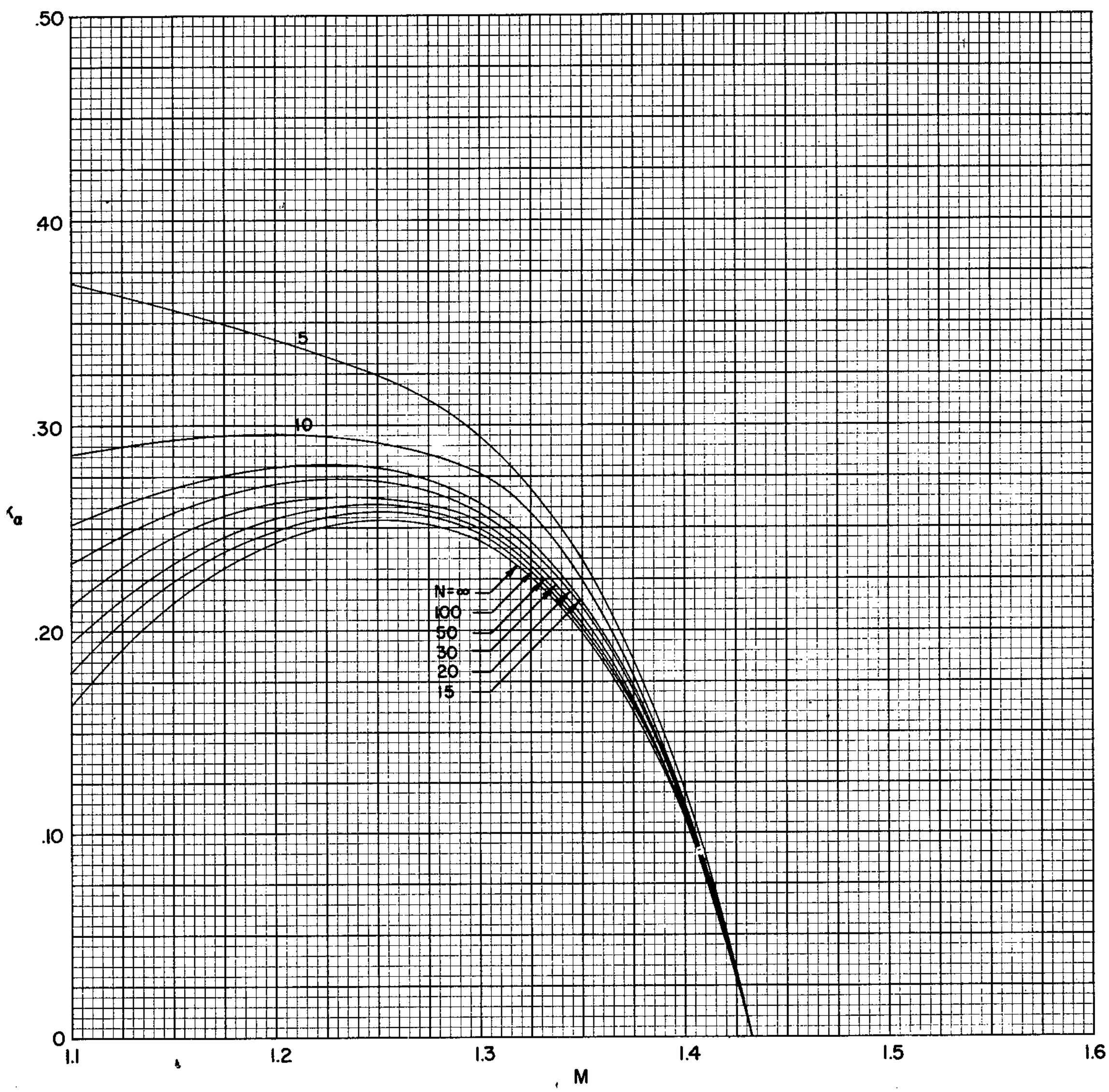


Figure 1201-5a STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER FOR ZERO DAMPING ($g_{\alpha} = 0$). r = 0

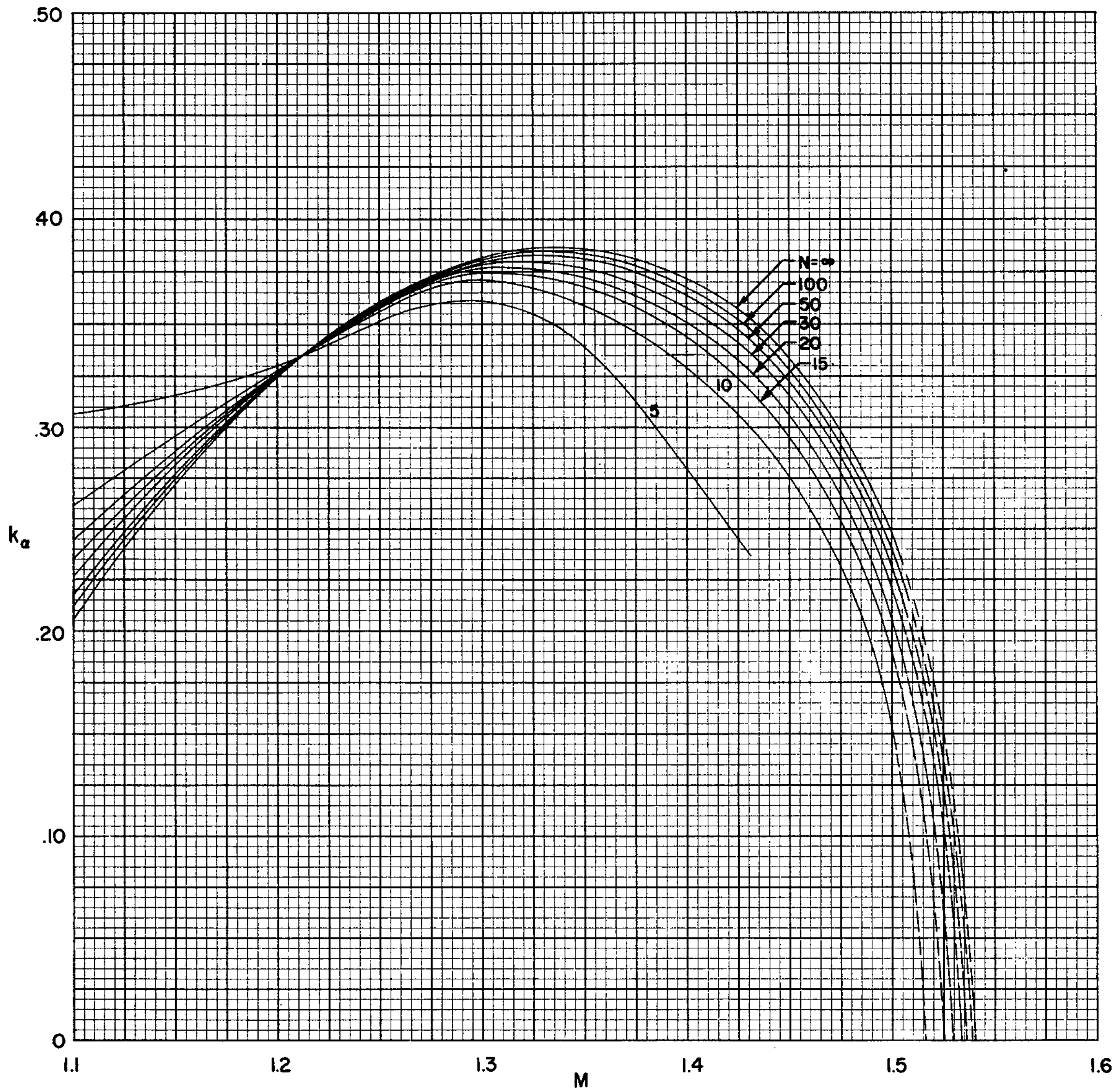


Figure 1201-5b STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER FOR ZERO DAMPING ($g_\alpha = 0$). $r = -0.2$

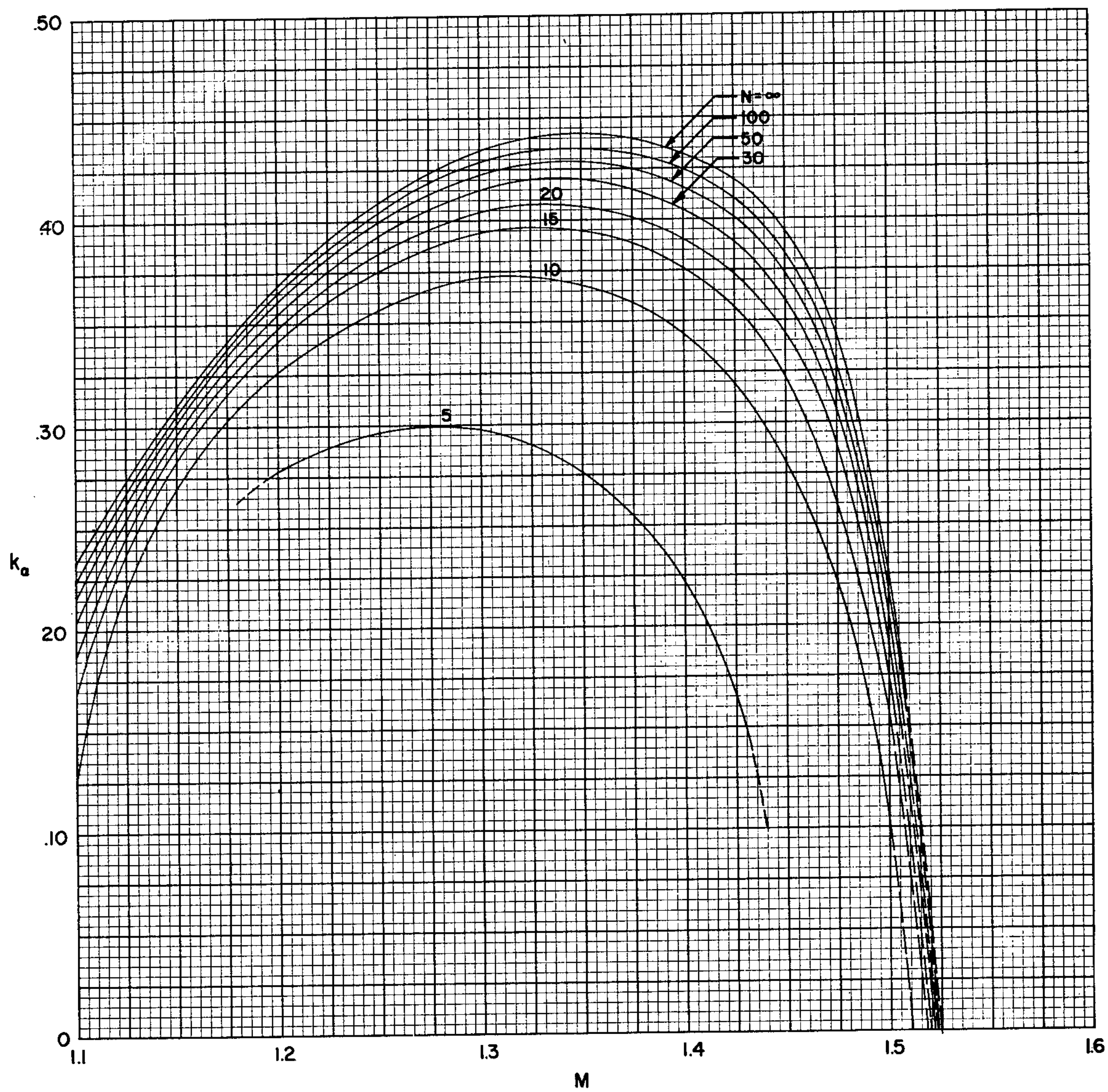


Figure 1201-5c STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER FOR ZERO DAMPING (g_α = 0). r = -0.4

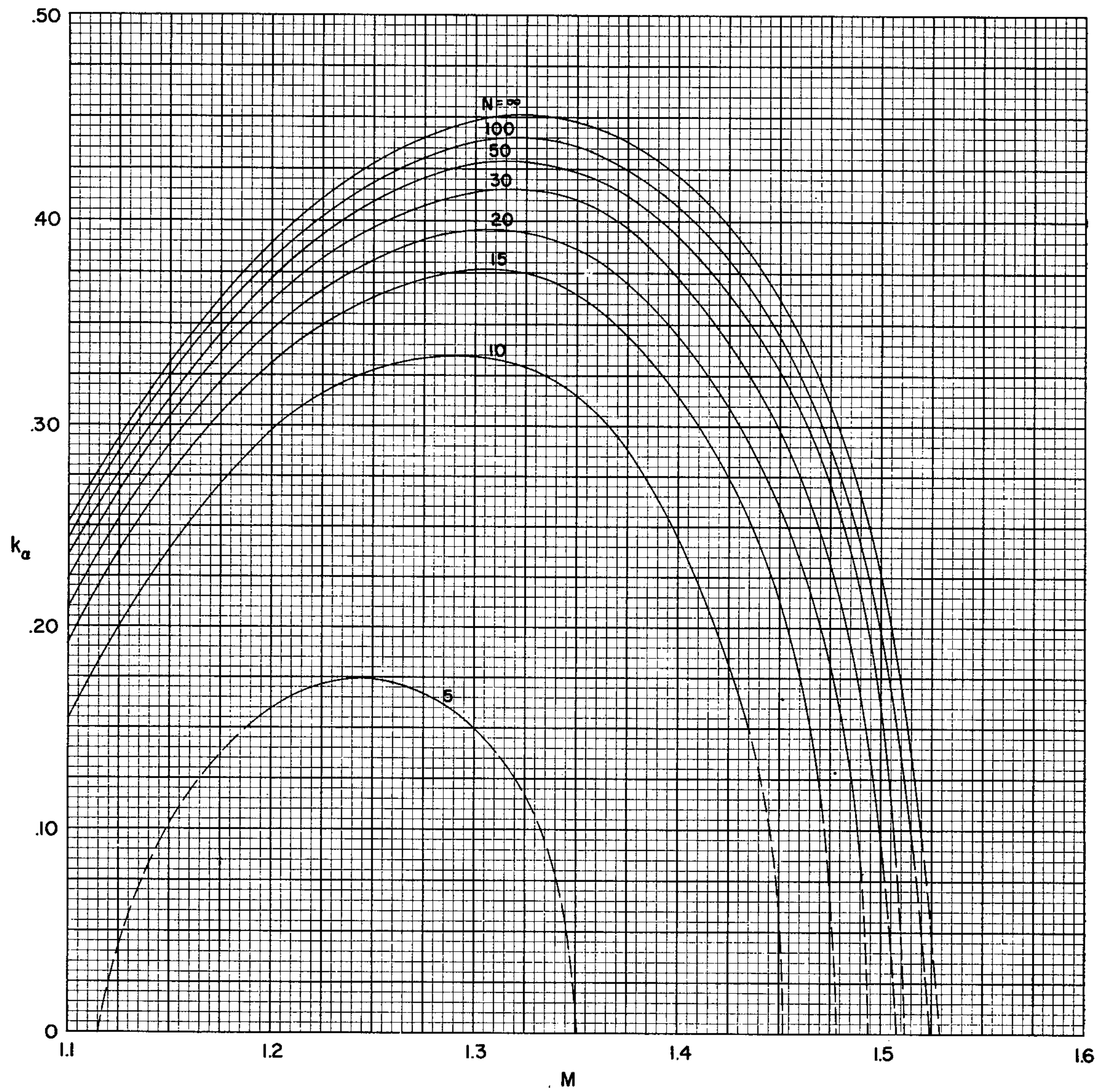


Figure 1201-5d STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER FOR ZERO DAMPING ($g_\alpha = 0$). $r = -0.6$

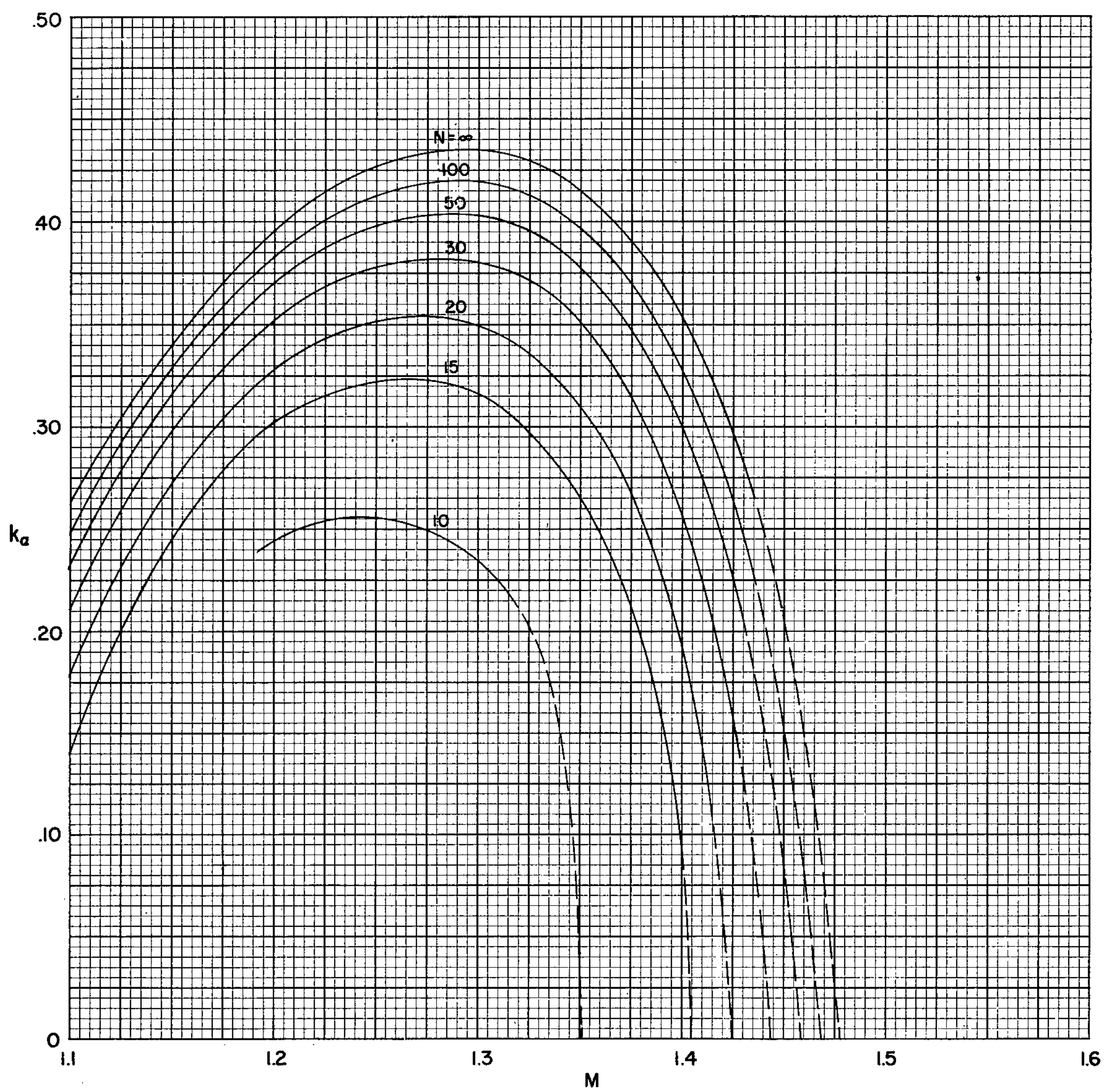


Figure 1201-5e STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER FOR ZERO DAMPING ($g_\alpha = 0$). $r = -0.8$

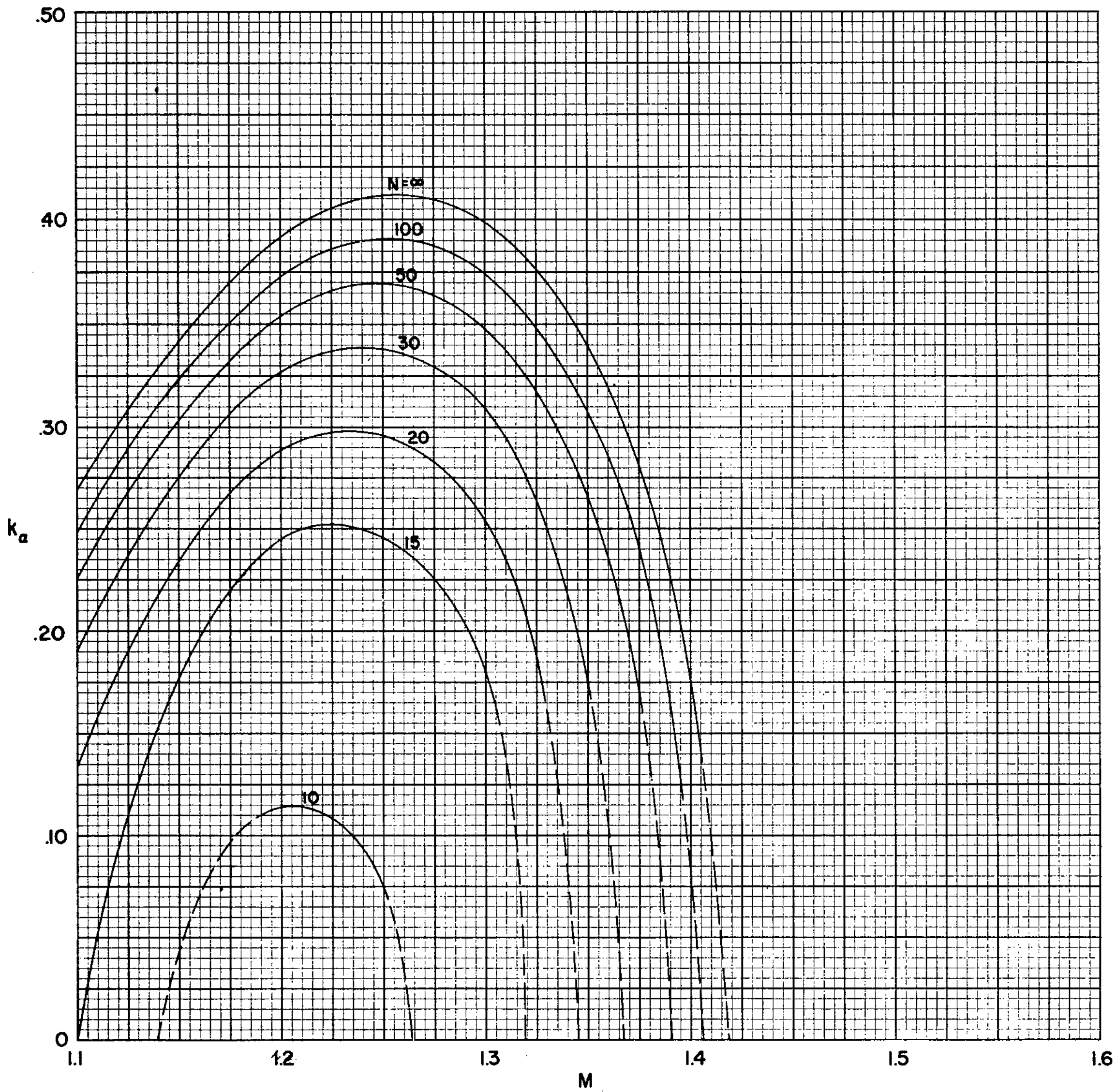


Figure 1201-5f STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER FOR ZERO DAMPING ($g_\alpha = 0$). $r = -1.0$

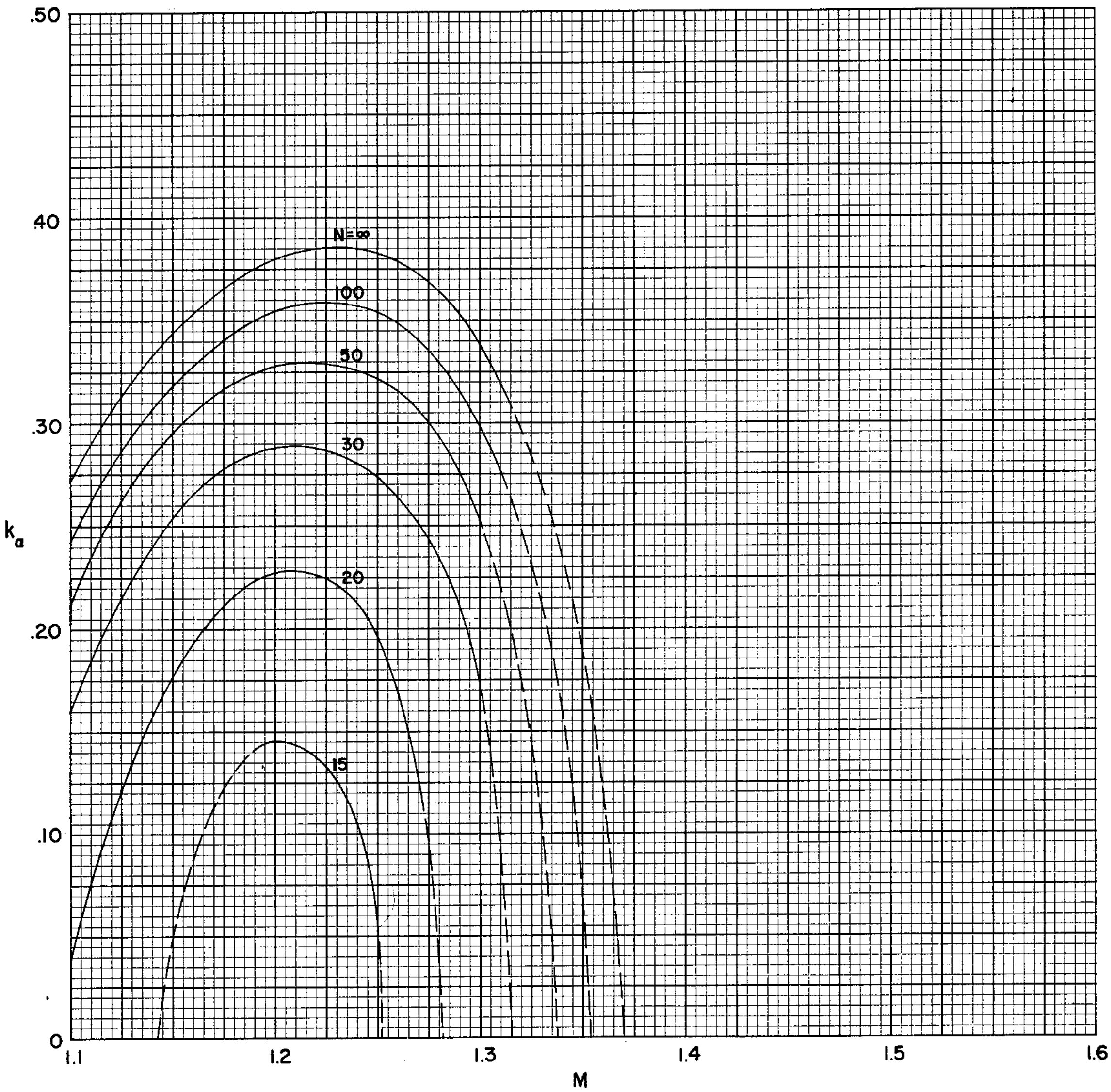


Figure 1201-5g STABILITY BOUNDARIES FOR SINGLE-DEGREE-OF-FREEDOM TORSIONAL FLUTTER FOR ZERO DAMPING ($g_\alpha = 0$). $r = -1.2$

1202 Two-Dimensional Binary Flexure-Torsion Flutter

The equations of motion for a two-dimensional airfoil in flexure and torsion are most easily derived (References 12-12 and 12-13) by use of the Lagrangian equations

$$\frac{d}{dt}\left(\frac{\partial E_k}{\partial \dot{q}_1}\right) + \frac{\partial E_e}{\partial q_1} + \frac{\partial F}{\partial \dot{q}_1} - L_g = 0$$

and

$$\frac{d}{dt}\left(\frac{\partial E_k}{\partial \dot{q}_2}\right) + \frac{\partial E_e}{\partial q_2} + \frac{\partial F}{\partial \dot{q}_2} - M_g = 0 \qquad (1202\text{-}1)$$

The quantities q_1 and q_2 are the generalized coordinates describing the motion of the system; they may be considered as the translational displacement h' of the wing elastic axis, and the angular displacement α, respectively, although this choice is not essential. Thus, for harmonic oscillatory motions we get:

$$h' = q_1 = h'_o\, e^{i\omega t}$$

$$\alpha = q_2 = \alpha_o\, e^{i\omega t} \qquad (1202\text{-}2)$$

The quantities L_g and M_g are the generalized aerodynamic force and moment per unit span, respectively.

The kinetic energy E_k of the system per unit span can be written as the sum of the translational and rotational energies about an axis through the center of gravity, as follows,

$$E_k = \frac{1}{2}\, m \left[h' + x_\alpha b\, \dot{\alpha} \right]^2 + \frac{1}{2} \left[I'_\alpha - m\,(x_\alpha b)^2 \right] \dot{\alpha}^2 \qquad (1202\text{-}3)$$

Expanding, substituting S for the mass unbalance quantity $mx_\alpha b$, and also writing the equations for the elastic energy E_e and half the rate of energy dissipation F per unit span, one obtains:

$$E_k = \frac{1}{2}\,(m\dot{h}'^2 + 2S\dot{h}'\dot{\alpha} + I'_\alpha \dot{\alpha}^2)$$

$$E_e = \frac{1}{2}\,(C_h h'^2 + C_\alpha \alpha^2) \qquad (1202\text{-}4)$$

$$F = \frac{1}{2}\left(\frac{g_h C_h}{\omega}\, \dot{h}'^2 + \frac{g_\alpha C_\alpha}{\omega}\, \dot{\alpha}^2\right)$$

By introducing the generalized coordinates q_1 and q_2 (Equations 1202-2) into these energy equations, taking derivatives, and then substituting into the Lagrangian equations of motion (Equations 1202-1), we have:

$$- \omega^2 m h_o' e^{i\omega t} - \omega^2 S \alpha_o e^{i\omega t} + C_h h_o' e^{i\omega t} + i g_h C_h h_o' e^{i\omega t} - L_g = 0$$

$$- \omega^2 I_\alpha' \alpha_o e^{i\omega t} - \omega^2 S h_o' e^{i\omega t} + C_\alpha \alpha_o e^{i\omega t} + i g_\alpha C_\alpha \alpha_o e^{i\omega t} - M_g = 0 \qquad (1202\text{-}5)$$

The generalized force and moment per unit span on a two-dimensional wing about the elastic axis (see Equations 1203-10) are:

$$L_g = L' = - \pi \rho b^3 \omega^2 e^{i\omega t} \left(A_{11} \frac{h_o'}{b} + A_{12}\, \alpha_o \right)$$

$$M_g = M' = - \pi \rho b^4 \omega^2 e^{i\omega t} \left(A_{21} \frac{h_o'}{b} + A_{22}\, \alpha_o \right) \qquad (1202\text{-}6)$$

where (see Equations 1203-9)

$$A_{11} = - C_{Lh}$$

$$A_{12} = C_{Lh} \left(\frac{1}{2} + r\right) - C_{L\alpha} \qquad (1202\text{-}7)$$

$$A_{21} = C_{Lh} \left(\frac{1}{2} + r\right) - C_{Mh}$$

$$A_{22} = - C_{M\alpha} - C_{Lh} \left(\frac{1}{2} + r\right)^2 + (C_{L\alpha} + C_{Mh}) \left(\frac{1}{2} + r\right)$$

By combining Equations 1202-5 and 1202-6, and rearranging (since $\omega_h = \sqrt{C_h/m}$, $\omega_\alpha = \sqrt{C_\alpha / I_\alpha'}$, and $S = m x_\alpha b$), we have:

$$\left\{ \frac{m}{\pi \rho b^2} \left[\left(\frac{\omega_h}{\omega}\right)^2 (1 + i g_h) - 1 \right] + A_{11} \right\} \frac{h_o'}{b} + \left\{ - \frac{m x_\alpha}{\pi \rho b^2} + A_{12} \right\} \alpha_o = 0$$

$$\left\{ - \frac{m x_\alpha}{\pi \rho b^2} + A_{21} \right\} \frac{h_o'}{b} + \left\{ \frac{I_\alpha'}{\pi \rho b^4} \left[\left(\frac{\omega_\alpha}{\omega}\right)^2 (1 + i g_\alpha) - 1 \right] + A_{22} \right\} \alpha_o = 0 \qquad (1202\text{-}8)$$

In order for a solution to exist, the determinant of Equations 1202-8 must vanish. That is,

$$\begin{vmatrix} M_{11} + A_{11} & M_{12} + A_{12} \\ M_{21} + A_{21} & M_{22} + A_{22} \end{vmatrix} = 0 \qquad (1202\text{-}9)$$

where

$$M_{11} = \frac{m}{\pi\rho b^2}\left[\left(\frac{\omega_h}{\omega}\right)^2 (1 + ig_h) - 1\right]$$

$$M_{12} = M_{21} = -\frac{mx_\alpha}{\pi\rho b^2} \tag{1202-10}$$

$$M_{22} = \frac{I'_\alpha}{\pi\rho b^4}\left[\left(\frac{\omega_\alpha}{\omega}\right)^2 (1 + ig_\alpha) - 1\right]$$

Some methods of solving the determinantal equation for two-dimensional binary flutter will be covered in Subsection 1204. The determinantal equations of motion derived here (Equations 1202-7, 1202-9 and 1202-10) are identical to those presented in Reference 12-14.

1203 Three-Dimensional Binary Flexure-Torsion Flutter

Let the quantities, h' and α, describing the motion of the three-dimensional (finite) wing referred to the elastic axis be defined by (cf. Equations 1202-2)

$$\begin{aligned} h' &= \phi_1 \, q_1 = \phi_1 h'_o e^{i\omega t} \\ \alpha &= \phi_2 \, q_2 = \phi_2 \alpha_o e^{i\omega t} \end{aligned} \qquad (1203\text{-}1)$$

where ϕ_1 and ϕ_2 are functions of the spanwise position, y. The quantities q_1 and q_2 are generalized coordinates; they may be considered respectively as the displacement of, and rotation at, the tip of the wing, although in any specific case some other quantity may be more convenient.

The kinetic energy E_k in such a system may be found from the spanwise integration (cf. Equation 1202-4)

$$E_k = \frac{1}{2}\left[\int_0^{\ell} m\dot{h}'^2 dy + 2\int_0^{\ell} S\dot{h}'\dot{\alpha}\, dy + \int_0^{\ell} I'_\alpha \dot{\alpha}^2 dy\right] \qquad (1203\text{-}2a)$$

The elastic energy E_e in such a system is

$$E_e = \frac{1}{2}\left[\int_0^{\ell} EI \left(\frac{\partial^2 h'}{\partial y^2}\right)^2 dy + \int_0^{\ell} GJ \left(\frac{\partial \alpha}{\partial y}\right)^2 dy\right] \qquad (1203\text{-}2b)$$

One-half the rate of energy dissipation is

$$F = \frac{1}{2}\left[-\frac{g_h}{\omega}\int_0^{\ell} EI \left(\frac{\partial^2 \dot{h}'}{\partial y^2}\right)^2 dy - \frac{g_\alpha}{\omega}\int_0^{\ell} GJ \left(\frac{\partial \dot{\alpha}}{\partial y}\right)^2 dy\right] \qquad (1203\text{-}2c)$$

Since h' and α have been defined in Equations 1203-1, derivatives necessary for substitution in Equations 1203-2 may be formed. After substitution we have:

$$\begin{aligned} E_k &= \frac{1}{2}\left[\int_0^{\ell} m\phi_1^2 \dot{q}_1^2 dy + 2\int_0^{\ell} S\phi_1\phi_2\dot{q}_1\dot{q}_2 dy + \int_0^{\ell} I'_\alpha \phi_2^2 \dot{q}_2^2 dy\right] \\ E_e &= \frac{1}{2}\left[\int_0^{\ell} EIq_1^2 \left(\frac{d^2\phi_1}{dy^2}\right)^2 dy + \int_0^{\ell} GJq_2^2\left(\frac{d\phi_2}{dy}\right)^2 dy\right] \\ F &= \frac{1}{2}\left[-\frac{g_h}{\omega}\int_0^{\ell} EI\dot{q}_1^2\left(\frac{d^2\phi_1}{dy^2}\right)^2 dy - \frac{g_\alpha}{\omega}\int_0^{\ell} GJ\dot{q}_2^2\left(\frac{d\phi_2}{dy}\right)^2 dy\right] \end{aligned} \qquad (1203\text{-}3)$$

The Lagrangian equations of motion for such a system of two degrees of freedom are (cf. Equations 1202-1):

$$\frac{d}{dt}\left(\frac{\partial E_k}{\partial \dot{q}_1}\right) + \frac{\partial E_e}{\partial q_1} + \frac{\partial F}{\partial \dot{q}_1} - L_g = 0 \qquad (1203\text{-}4)$$

$$\frac{d}{dt}\left(\frac{\partial E_k}{\partial \dot{q}_2}\right) + \frac{\partial E_e}{\partial q_2} + \frac{\partial F}{\partial \dot{q}_2} - M_g = 0$$

where L_g and M_g are the generalized aerodynamic force and moment per unit span acting on the wing, referred to the generalized coordinates q_1 and q_2, respectively. The former will be more fully defined in Equations 1203-7 and 1203-8, respectively.

Taking the necessary partial derivatives of the energy equations (1203-3) and substituting into the Lagrangian equations (1203-4), we have:

$$- \omega^2 e^{i\omega t} h_o' \int_0^{\ell} m\phi_1^2 dy - \omega^2 e^{i\omega t} \alpha_o \int_0^{\ell} S\, \phi_1\, \phi_2 dy + h_o' e^{i\omega t} \int_0^{\ell} EI \left(\frac{d^2 \phi_1}{dy^2}\right)^2 dy$$
$$+ ig_h h_o' e^{i\omega t} \int_0^{\ell} EI \left(\frac{d^2\phi_1}{dy^2}\right)^2 dy - L_g = 0 \qquad (1203\text{-}5)$$

$$- \omega^2 e^{i\omega t} h_o' \int_0^{\ell} S\, \phi_1\, \phi_2 dy - \omega^2 e^{i\omega t} \alpha_o \int_0^{\ell} I_\alpha' \phi_2^2 dy + \alpha_o e^{i\omega t} \int_0^{\ell} GJ \left(\frac{d\,\phi_2}{dy}\right)^2 dy$$
$$+ ig_\alpha \alpha_o e^{i\omega t} \int_0^{\ell} GJ \left(\frac{d\,\phi_2}{dy}\right)^2 dy - M_g = 0 \qquad (1203\text{-}6)$$

Borbely's and Possio's equations for the lift and moment on a unit span of two-dimensional wing oscillating in flexure and torsion are derived in References 12-1 and 12-15, respectively, and are reproduced in Reference 12-14. Using the coefficients defined by Equations 1201-3, the force and moment about the elastic axis may be written, respectively:

$$L' = - \pi\rho b^3 \omega^2 e^{i\omega t}\left\{- C_{Lh} \frac{h_o'}{b} + \left[\left(\frac{1}{2} + r\right) C_{Lh} - C_{L\alpha}\right] \alpha_o\right\} \qquad (1203\text{-}7)$$

$$M' = - \pi\rho b^4 \omega^2 e^{i\omega t}\left\{\left[- C_{Mh} + \left(\frac{1}{2} + r\right) C_{Lh}\right] \frac{h_o'}{b} + \left[- C_{M\alpha}\right.\right.$$
$$\left.\left. - C_{Lh}\left(\frac{1}{2} + r\right)^2 + C_{L\alpha}\left(\frac{1}{2} + r\right) + C_{Mh}\left(\frac{1}{2} + r\right)\right] \alpha_o\right\} \qquad (1203\text{-}8)$$

(Note- This equation for M' is derived independently in Subsection 1201; see Equation 1201-5 and the note that follows it.)

For convenience, let

$$
\begin{aligned}
A_{11} &= -\, C_{Lh} \\
A_{12} &= C_{Lh} \left(\frac{1}{2} + r\right) - C_{L\alpha} \\
A_{21} &= C_{Lh} \left(\frac{1}{2} + r\right) - C_{Mh} \\
A_{22} &= -\, C_{M\alpha} - C_{Lh} \left(\frac{1}{2} + r\right)^2 + C_{L\alpha}\left(\frac{1}{2} + r\right) + C_{Mh}\left(\frac{1}{2} + r\right)
\end{aligned}
\tag{1203-9}
$$

Then, for two-dimensional wings,

$$
\begin{aligned}
L' &= -\pi\rho b^3\omega^2 e^{i\omega t}\left(A_{11}\frac{h_o'}{b} + A_{12}\alpha_o\right) \\
M' &= -\pi\rho b^4\omega^2 e^{i\omega t}\left(A_{21}\frac{h_o'}{b} + A_{22}\alpha_o\right)
\end{aligned}
\tag{1203-10}
$$

For three-dimensional wings, taking into account the spanwise variations of displacement (cf. Equations 1202-2 and 1203-1), we have

$$
\begin{aligned}
L' &= -\pi\rho b^3\omega^2 e^{i\omega t}\left(A_{11}\frac{\phi_1 h_o'}{b} + A_{12}\,\phi_2\,\alpha_o\right) \\
M' &= -\pi\rho b^4\omega^2 e^{i\omega t}\left(A_{21}\frac{\phi_1 h_o'}{b} + A_{22}\,\phi_2\,\alpha_o\right)
\end{aligned}
\tag{1203-11}
$$

By the principle of virtual work, and by use of Equations 1203-1 and 1203-11, the generalized moments and forces may then be expressed as follows:

$$
\begin{aligned}
L_g &= -\pi\rho\omega^2 e^{i\omega t}\left[h_o'\int_0^{\ell} b^2 A_{11}\phi_1^2\,dy + \alpha_o\int_0^{\ell} b^3 A_{12}\,\phi_1\phi_2\,dy\right] \\
M_g &= -\pi\rho\omega^2 e^{i\omega t}\left[h_o'\int_0^{\ell} b^3 A_{21}\,\phi_1\,\phi_2\,dy + \alpha_o\int_0^{\ell} b^4 A_{22}\,\phi_2^2\,dy\right]
\end{aligned}
\tag{1203-12}
$$

These may be substituted into Equations 1203-5 and 1203-6, respectively, to obtain the equations of motion, thus:

$$
\begin{aligned}
(M_{11}' + A_{11}')\,h_o' + (M_{12}' + A_{12}')\,\alpha_o &= 0 \\
(M_{21}' + A_{21}')\,h_o' + (M_{22}' + A_{22}')\,\alpha_o &= 0
\end{aligned}
\tag{1203-13}
$$

A necessary condition for the existence of a solution of these equations is

$$
\begin{vmatrix}
M_{11}' + A_{11}' & M_{12}' + A_{12}' \\
M_{21}' + A_{21}' & M_{22}' + A_{22}'
\end{vmatrix} = 0
\tag{1203-14}
$$

where

$$
\begin{aligned}
M'_{11} &= -\int_0^{\ell} m\phi_1^{\,2}\,dy + \frac{1}{\omega^2}(1 + ig_h)\int_0^{\ell} EI\left(\frac{d^2\phi_1}{dy^2}\right)^2 dy \\
M'_{12} &= M'_{21} = -\int_0^{\ell} S\phi_1\phi_2\,dy \\
M'_{22} &= -\int_0^{\ell} I'_\alpha\phi_2^{\,2}\,dy + \frac{1}{\omega^2}(1 + ig_\alpha)\int_0^{\ell} GJ\left(\frac{d\phi_2}{dy}\right)^2 dy \\
A'_{11} &= \pi\rho\int_0^{\ell} b^2A_{11}\phi_1^{\,2}\,dy, \\
A'_{12} &= \pi\rho\int_0^{\ell} b^3A_{12}\phi_1\phi_2\,dy \\
A'_{21} &= \pi\rho\int_0^{\ell} b^3A_{21}\phi_1\phi_2\,dy \\
A'_{22} &= \pi\rho\int_0^{\ell} b^4A_{22}\phi_2^{\,2}\,dy
\end{aligned}
\tag{1203-15}
$$

In general, for three-dimensional wings, each factor in every one of the foregoing integrands is a function of its spanwise location, for various reasons as indicated below:

Wing Characteristic Determining the Spanwise Function	Quantities So Determined
Mass distribution	m, S, I'_α
Material	E, G
Cross-section form	I, J
Planform	b
Planform and elastic axis location	A_{11}, A_{12}, A_{21}, A_{22}
Mode shape in flexure	ϕ_1
Mode shape in torsion	ϕ_2

Further, it is seen that the quantities M'_{11}, M'_{12}, M'_{21}, and M'_{22} are functions of the mechanical parameters and frequency, but not of the flight conditions. However, the aerodynamic terms A'_{11}, A'_{12}, A'_{21} and A'_{22}, are functions of Mach number and the location of the elastic axis relative to the mid-chord line, as well as of the frequency and certain mechanical parameters.

For special cases, the above equations may be simplified to a large extent; for instance, a uniform rectangular cantilever wing would enable the computer to remove all terms other than ϕ_1 and ϕ_2 from the integrands.

Several methods of solving the determinantal equations (e.g. Equations 1202-9 and 1203-14) are possible. A method based on that of the U. S. Air Force Air Materiel Command (Reference 12-2) is presented as an example in Subsection 1204.

1204 Applications of Determinantal Equation for Two-Dimensional Binary Flutter

1204.0 Discussion

The determinantal equation for two-dimensional binary flutter (cf. Equation 1202-9) is

$$\begin{vmatrix} M_{11} + A_{11} & M_{12} + A_{12} \\ M_{21} + A_{21} & M_{22} + A_{22} \end{vmatrix} = 0 \qquad (1204.0\text{-}1)$$

where, (cf. Equations 1202-7 and 1202-10):

$$M_{11} = \frac{m}{\pi\rho b^2}\left[\left(\frac{\omega_h}{\omega}\right)^2 (1 + ig_h) - 1\right]$$

$$M_{12} = M_{21} = -\frac{mx_\alpha}{\pi\rho b^2}$$

$$M_{22} = \frac{I'_\alpha}{\pi\rho b^4}\left[\left(\frac{\omega_\alpha}{\omega}\right)^2 (1 + ig_\alpha) - 1\right] \qquad (1204.0\text{-}2)$$

$$A_{11} = -C_{Lh}$$

$$A_{12} = C_{Lh}\left(\frac{1}{2} + r\right) - C_{L\alpha}$$

$$A_{21} = C_{Lh}\left(\frac{1}{2} + r\right) - C_{Mh}$$

$$A_{22} = -C_{M\alpha} - C_{Lh}\left(\frac{1}{2} + r\right)^2 + (C_{L\alpha} + C_{Mh})\left(\frac{1}{2} + r\right)$$

A number of fairly simple solutions to the foregoing determinantal equation have been obtained, and one of these is outlined in the following subsection.

1204.1 Materiel Center Method (References 12-2 and 12-16)

Let $g_\alpha = g_h = g$

$$Z = \left(\frac{\omega_\alpha}{\omega}\right)^2 \qquad (1204.1\text{-}1)$$

$$\Lambda = Z(1 + ig)$$

and $k_{h\alpha} = \left(\dfrac{\omega_h}{\omega_\alpha}\right)^2$

Then

$$M_{11} = \frac{m}{\pi\rho b^2}\left(k_{h\alpha}\Lambda - 1\right) \qquad (1204.1\text{-}2)$$

$$M_{22} = \frac{I'_\alpha}{\pi\rho b^4}\left(\Lambda - 1\right)$$

The determinantal equation may therefore be written

$$\Lambda^2 + C_1 \Lambda + C_2 = 0 \tag{1204.1-3}$$

where C_1 and C_2 are complex constants.

The two complex roots of this quadratic equation are given by

$$\Lambda = \frac{-C_1 \pm \sqrt{C_1^2 - 4C_2}}{2} \tag{1204.1-4}$$

By complex algebra it is readily shown that

$$\sqrt{C_1^2 - 4C_2} = \sqrt[4]{\zeta^2 + \eta^2}\left(\cos\frac{\theta}{2} + i\sin\frac{\theta}{2}\right) \tag{1204.1-5}$$

where

$$\zeta = \overline{(C_1^2 - 4C_2)}$$

$$\eta = (C_1^2 - 4C_2)^*$$

$$\theta = \arc\tan\frac{\eta}{\zeta}$$

Hence we may write the real and complex parts of the two roots of Equation 1204.1-4 as follows:

$$\begin{aligned}
2\bar{\Lambda}_1 &= -\bar{C}_1 + \sqrt[4]{\zeta^2 + \eta^2}\cos\frac{\theta}{2} \\
2\bar{\Lambda}_2 &= -\bar{C}_1 - \sqrt[4]{\zeta^2 + \eta^2}\cos\frac{\theta}{2} \\
2\Lambda_1^* &= -C_1^* + \sqrt[4]{\zeta^2 + \eta^2}\sin\frac{\theta}{2} \\
2\Lambda_2^* &= -C_1^* - \sqrt[4]{\zeta^2 + \eta^2}\sin\frac{\theta}{2}
\end{aligned} \tag{1204.1-6}$$

By the definitions of Equations 1204.1-1 it is apparent that

$$\begin{aligned}
\left(\frac{\omega_{\alpha 1}}{\omega}\right)^2 &= \bar{\Lambda}_1 \\
\left(\frac{\omega_{\alpha 2}}{\omega}\right)^2 &= \bar{\Lambda}_2
\end{aligned} \tag{1204.1-7}$$

and since ω must be assumed in order for values of the aerodynamic coefficients to be chosen, then the values of ω_α are determined for this value of ω and for the simultaneously assumed value of Mach number M.

It is also apparent by the definitions of Equations 1204.1-1 that the damping coefficients are:

$$g_1 = \frac{\Lambda_1^*}{\bar{\Lambda}_1}$$
$$g_2 = \frac{\Lambda_2^*}{\bar{\Lambda}_2} \qquad (1204.1\text{-}8)$$

Thus, the procedure for determining the stability of the wing at a given Mach number consists of:

(a) Assuming a series of values for the reduced frequency k, thereby determining the values of the frequency parameter Ω and of the aerodynamic coefficients which will be used in the determinantal equation; then, using these coefficients in solving the determinantal equation for the natural frequency in torsion and for the damping factor.

(b) Plotting these computed damping factors against some convenient parameter such as ω_α or $\omega_\alpha b/a$.

(c) Determining experimentally, or estimating from experience, the actual damping factors of the wing; and plotting this factor on the graph referred to in (b).

If, at a particular value of Mach number and natural frequency ω_α, the actual damping factor of the wing is greater than the computed value (i.e., if the point representing the experimental value lies above the curve representing the computed values) then freedom from flutter is indicated.

1204.11 Numerical Example by the Materiel Center Method

Let the following values be assumed to define the characteristics of a two-dimensional wing that is to be examined for binary flutter:

$$\frac{m}{\pi \rho b^2} = 100.0$$
$$\frac{I'_\alpha}{\pi \rho b^4} = 16.67$$
$$\frac{\omega_h}{\omega_\alpha} = 0.700 \qquad (1204.11\text{-}1)$$
$$r = 0$$
$$x_\alpha = 0$$

These values, when substituted in the M-terms (Equations 1204.0-2) of the determinantal equation give:

$$M_{11} = 100.0\ (0.4900\ \Lambda\ -1)$$
$$M_{12} = M_{21} = 0 \qquad (1204.11\text{-}2)$$

$$M_{22} = 16.67\ (\Lambda - 1)$$

2.0

Let the flight Mach number (M) of interest be 1.4, and let the frequency range of interest be defined by a range from 0.2 to 0.7 for the frequency parameter Ω. For this immediate part of the numerical example the value 0.4 is chosen for the latter quantity.

That is

$$M = 1.4$$
$$\Omega = 0.4 \qquad (1204.11\text{-}3)$$

These two values determine the aerodynamic coefficients (as tabulated in Table 1208.2) to be:

$$C_{Lh} = -1.31345 - i\ 12.999891$$
$$C_{L\alpha} = -132.93679 + i\ 6.776163 \qquad (1204.11\text{-}4)$$
$$C_{Mh} = -1.08389 - i\ 6.367874$$
$$C_{M\alpha} = -65.34705 + i\ 3.340791$$

For r = 0 and for these coefficients, the A-terms (Equation 1204.0-2) of the determinantal equation become:

$$A_{11} = 1.313 + i\ 13.000$$
$$A_{12} = 132.280 - i\ 13.276 \qquad (1204.11\text{-}5)$$
$$A_{21} = 0.427 - i\ 0.132$$
$$A_{22} = -1.335 + i\ 0.113$$

Substituting these values for the M-terms (Equation 1204.11-2) and the A-terms (Equations 1204.11-5) into the determinantal equation 1204.0-1, we get:

$$\begin{vmatrix} 49.00\,\Lambda - 98.69 + i\ 13.00 & 132.28 - i\ 13.28 \\ 0.4272 - i\ 0.1321 & 16.67\,\Lambda - 18.00 + i\ 0.1133 \end{vmatrix} \doteq 0 \qquad (1204.11\text{-}6)$$

This equation when expanded and simplified gives

$$\Lambda^2 + (-3.094 + i\ 0.2721)\,\Lambda + (2.106 - i\ 0.2719) = 0 \qquad (1204.11\text{-}7)$$

By comparison of this equation with Equation 1204.1-3 it is apparent that the complex constants are:

$$C_1 = -3.094 + i\ 0.2721$$
$$C_2 = 2.106 - i\ 0.2719 \qquad (1204.11\text{-}8)$$

The quantities that appear in the roots of the determinantal equation can be calculated by Equations 1204.1-5 as follows:

$$
\begin{aligned}
C_1^{\,2} &= 9.4994 - i\,1.6838 \\
4\,C_2 &= 8.42\overset{60}{\cancel{58}} - i\,1.0876 \\
C_1^{\,2} - 4\,C_2 &= 1.073\overset{4}{\cancel{5}} - i\,0.5962 \\
\zeta &= 1.073\overset{4}{\cancel{5}} \\
\eta &= -0.5962 \\
\sqrt[4]{\zeta^2 + \eta^2} &= 1.1081 \\
\theta &= -29^\circ\ \overset{2.9'}{\cancel{2.74}}'
\end{aligned}
\qquad (1204.11\text{-}9)
$$

The real and imaginary parts of the two roots of the quadratic equation are therefore, by use of Equations 1204.1-6:

$$
\begin{aligned}
\bar{\Lambda}_1 &= 2.083 \\
\bar{\Lambda}_2 &= 1.011 \\
\Lambda_1^{*} &= -0.2750 \\
\Lambda_2^{*} &= 0.0029
\end{aligned}
\qquad (1204.11\text{-}10)
$$

By Equations 1204.1-7 it is apparent that the natural frequencies of the wings (ω_α) in relation to the circular frequency (ω) corresponding to the specified Mach number and frequency parameter are given by:

$$
\begin{aligned}
\frac{\omega_{\alpha 1}}{\omega} &= 1.443 \\
\frac{\omega_{\alpha 2}}{\omega} &= 1.005
\end{aligned}
\qquad (1204.11\text{-}11)
$$

A convenient non-dimensional parameter for the natural frequency is $\omega_\alpha\, b/a$; this can be derived from the foregoing ratio by the identity

$$\frac{\omega_\alpha\, b}{a} = \frac{\omega_\alpha}{\omega} \cdot \frac{\omega\, b}{V} \cdot \frac{V}{a}$$

where $\omega b/V$ (the reduced frequency k) is related to Mach number M and frequency parameter Ω as indicated in the list of symbols and in Table 1208.1.

For this numerical example we therefore find that

$$\frac{\omega\, b}{V} = 0.09796 \qquad (1204.11\text{-}12)$$

and

$$\frac{V}{a} = 1.4$$

Therefore,

$$\frac{\omega_{\alpha 1} b}{a} = 0.1980$$
$$\frac{\omega_{\alpha 2} b}{a} = 0.1379 \tag{1204.11-13}$$

By Equations 1204.1-8 it is apparent that the damping coefficients corresponding to the two roots of the flutter equation are:

$$g_1 = -0.1320$$
$$g_2 = +0.0029 \tag{1204.11-14}$$

Similar computations of $\omega_\alpha b/a$ (the reduced natural frequency k_α), and of g, have been ~~computed~~ for Ω = 0.2, to 2.0, 0.25, 0.3, 0.5, 0.6, 0.7, ~~and 1.0~~ and ~~then~~ all of these values have been plotted (g vs k_α) in Figure 1204.11-1, for Mach number 1.4. In an actual investigation of the flutter characteristics of a wing similar computations and graphs would be computed for each of several other Mach numbers.

The actual value of the quantity k_α for the sample wing may be determined by experiment or estimated from experience. In the former case the natural frequency in torsion of the wing (ω_α in radians per second) would be measured, and also an average or effective semi-chord length of the wing would be determined. In addition, for each altitude of interest a value for the velocity of sound would be determined corresponding to the ambient temperature and composition of the air at that level.

Likewise the actual value of the damping factor of the wing in torsion would be determined by measuring the rate of decay of a damped torsional vibration of the wing structure, or by measuring the power required to sustain such a vibration at constant amplitude - or an estimate could be made of the torsional damping factor from past experiences. A similar determination would be made of the flexural damping factor of the wing structure, and both of these damping factors would be used in selecting a suitable common damping factor for the wing being considered.

The point representing the value of the damping factor (g) and of the non-dimensional parameter for the reduced natural frequency (k_α) of the wing at a given altitude would then be plotted on the previously computed graphs such as represented in Figure 1204.11-1 for each Mach number of interest. If the point for the experimental quantities lies above both curves representing the two roots of the equation it is concluded that flutter is improbable. For example, if the quantity k_α for the wing at sea level is 0.2527 and the smaller of the two damping factors is 0.0032 it is seen that the point representing this wing on the graph of Figure 1204.11-1, for M = 1.4 lies above both curves and therefore the wing appears to be free from flutter at this Mach number. Similar spotting of the experimental values on the graphs for other Mach numbers would be made to determine the possibility of flutter occurring at each of these Mach numbers.

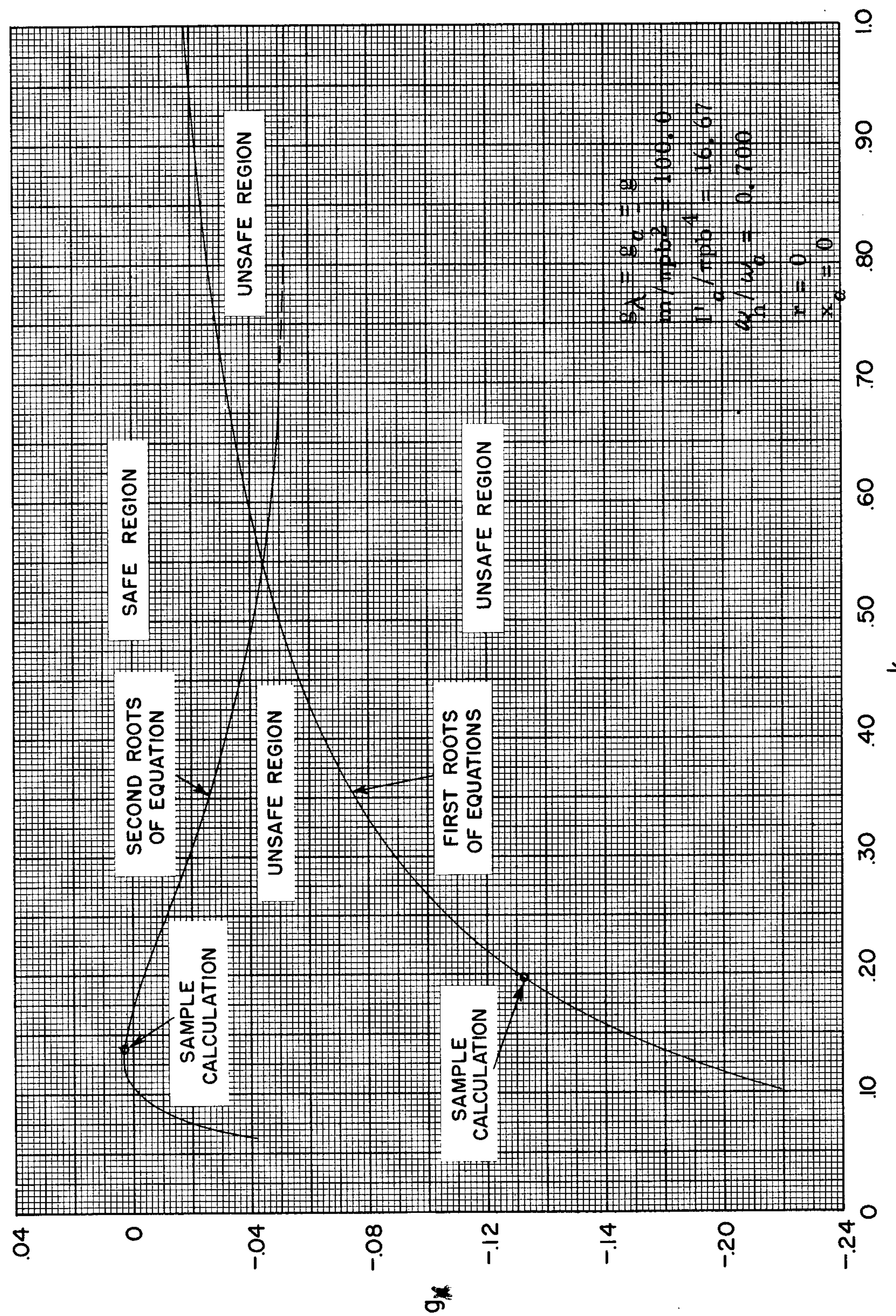


Figure 1204.11-1 ROOTS OF EQUATIONS DETERMINING STABILITY BOUNDARY FOR BINARY FLEXURE-TORSION FLUTTER. MATERIEL CENTER METHOD. M = 1.4

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1205 Three-Dimensional Ternary Flexure-Flexure-Torsion Flutter

(References 12-12 and 12-13)

In many cases of three-dimensional systems it will be found that the natural frequency in bending in the second mode may be nearly equal to the natural frequency in torsion. If this is found to be true, then it may be expected that the second bending mode will affect the flutter characteristics. In order to include the effects of the additional bending mode, let:

$$h = h_1 + h_2$$

$$h_1 = \phi_1(y)q_1(t) = \phi_1 h_{1o}e^{i\omega t}$$

$$h_2 = \phi_2(y)q_2(t) = \phi_2 h_{2o}e^{i\omega t} \qquad (1205\text{-}1)$$

$$\alpha = \phi_3(y)q_3(t) = \phi_3\alpha_o e^{i\omega t}$$

The process of determining the kinetic and elastic energies of the system, taking appropriate derivatives and substituting in the Lagrangian equations of motion, can be followed as in Subsection 1203. If this is done, the condition that the equations of motion have a solution will be

$$\begin{vmatrix} M''_{11} + A''_{11} & M''_{12} + A''_{12} & M''_{13} + A''_{13} \\ M''_{21} + A''_{21} & M''_{22} + A''_{22} & M''_{23} + A''_{23} \\ M''_{31} + A''_{31} & M''_{32} + A''_{32} & M''_{33} + A''_{33} \end{vmatrix} = 0 \qquad (1205\text{-}2)$$

where

$$M''_{11} = \int_0^{\ell} m\phi_1^2\left[\left(\frac{\omega_{h1}}{\omega}\right)^2(1 + ig_{h1}) - 1\right]dy$$

$$M''_{12} = M''_{21} = -\int_0^{\ell} m\phi_1\phi_2 dy = 0 \text{ (by orthogonality)}$$

$$M''_{13} = M''_{31} = -\int_0^{\ell} S\phi_1\phi_3 dy \qquad (1205\text{-}3)$$

$$M''_{22} = \int_0^{\ell} m\phi_2^2\left[\left(\frac{\omega_{h2}}{\omega}\right)^2(1 + ig_{h2}) - 1\right]dy$$

$$M''_{23} = M''_{32} = -\int_0^{\ell} S\phi_2\phi_3 dy$$

$$M''_{33} = \int_0^{\ell} I_\alpha\phi_3^2\left[\left(\frac{\omega_\alpha}{\omega}\right)^2(1 + ig_\alpha) - 1\right]dy$$

$$
\begin{aligned}
A''_{11} &= \pi\rho \int_0^{\ell} b^2 A_{11} \phi_1^2 \, dy \\
A''_{12} &= A''_{21} = \pi\rho \int_0^{\ell} b^2 A_{11} \phi_1 \phi_2 \, dy \\
A''_{13} &= \pi\rho \int_0^{\ell} b^3 A_{12} \phi_1 \phi_2 \, dy \\
A''_{22} &= \pi\rho \int_0^{\ell} b^2 A_{11} \phi_2^2 \, dy \\
A''_{23} &= \pi\rho \int_0^{\ell} b^3 A_{12} \phi_2 \phi_3 \, dy \\
A''_{31} &= \pi\rho \int_0^{\ell} b^3 A_{21} \phi_1 \phi_3 \, dy \\
A''_{32} &= \pi\rho \int_0^{\ell} b^3 A_{21} \phi_2 \phi_3 \, dy \\
A''_{33} &= \pi\rho \int_0^{\ell} b^4 A_{22} \phi_3^2 \, dy
\end{aligned}
\qquad (1205\text{-}4)
$$

The values of the unprimed A_{11}, A_{12}, A_{21}, A_{22} are the same as in Subsection 1202 (Equation 1202-7). The method of solving Equation 1205-2 will be discussed in Subsection 1207. An application of this general method to subsonic flutter is given in References 12-12 and 12-13.

1206 Two-Dimensional Ternary Flexure-Torsion-Aileron Flutter

The determinantal equation for two-dimensional ternary bending-torsion-aileron flutter may be written, corresponding to that for binary flutter (Equation 1202-9), as

$$\begin{vmatrix} M_{11} + A_{11} & M_{12} + A_{12} & M_{13} + A_{13} \\ M_{21} + A_{21} & M_{22} + A_{22} & M_{23} + A_{23} \\ M_{31} + A_{31} & M_{32} + A_{32} & M_{33} + A_{33} \end{vmatrix} = 0 \qquad (1206\text{-}1)$$

where M_{11} . . . . M_{22} and A_{11} . . . . A_{22} are exactly as defined in Subsection 1202. These are repeated here for convenience. In addition, the forces and moments about the elastic axis due to the motion of the aileron, and the moments about the aileron hinge line also are given here. Thus,

$$M_{11} = \frac{m}{\pi\rho b^2}\left[\left(\frac{\omega_h}{\omega}\right)^2 (1 + ig_h) - 1\right]$$

$$M_{12} = M_{21} = -\frac{mx_\alpha}{\pi\rho b^2}$$

$$M_{22} = \frac{I_\alpha}{\pi\rho b^4}\left[\left(\frac{\omega_\alpha}{\omega}\right)^2 (1 + ig_\alpha) - 1\right] \qquad (1206\text{-}2)$$

$$M_{13} = M_{31} = -\frac{m_\beta x_\beta}{\pi\rho b^2}$$

$$M_{23} = M_{32} = -\frac{I_\beta}{\pi\rho b^4} - \frac{m_\beta}{\pi\rho b^2}(c - r)\, x_\beta$$

$$M_{33} = \frac{I_\beta}{\pi\rho b^4}\left[\left(\frac{\omega_\beta}{\omega}\right)^2 (1 + ig_\beta) - 1\right]$$

The aerodynamic coefficients not involving the aileron are identically as given in Equations 1202-7, that is:

$$A_{11} = -C_{Lh}$$

$$A_{12} = C_{Lh}\left(\frac{1}{2} + r\right) - C_{L\alpha} \qquad (1206\text{-}3)$$

$$A_{21} = C_{Lh}\left(\frac{1}{2} + r\right) - C_{Mh}$$

$$A_{22} = -C_{M\alpha} - C_{Lh}\left(\frac{1}{2} + r\right)^2 + (C_{L\alpha} + C_{Mh})\left(\frac{1}{2} + r\right)$$

The aerodynamic terms involving the aileron are:

$$A_{13} = -\left(\frac{1-c}{2}\right)^3 \left(\frac{1}{2} C'_{Lh} + C'_{L\alpha}\right)$$

$$A_{23} = -\left(\frac{1-c}{2}\right)^4 \left[C'_{M\alpha} + C'_{Lh}\left(\frac{c-r}{1-c} + \frac{1}{4}\right) + C'_{L\alpha}\left(2\,\frac{c-r}{1-c} + \frac{1}{2}\right) + \frac{1}{2} C'_{Mh}\right]$$

$$A_{31} = C_{Lh}\left(\frac{1}{2} + c\right) - C_{Mh} - \left(\frac{1+c}{2}\right)^{3\cancel{4}} \left(\frac{3}{2} C''_{Lh} - C''_{Mh}\right) \qquad (1206\text{-}4)$$

$$A_{32} = -C_{M\alpha} - C_{Lh}\left(\frac{1}{2} + r\right)\left(\frac{1}{2} + c\right) + C_{L\alpha}\left(\frac{1}{2} + c\right) + C_{Mh}\left(\frac{1}{2} + r\right)$$

$$-\left(\frac{1+c}{2}\right)^4 \left[-C''_{M\alpha} - \frac{3}{2} C''_{Lh}\left(2\,\frac{r+1}{c+1} - \frac{1}{2}\right) + C''_{\substack{\cancel{L\alpha}\\ Mh}}\left(2\,\frac{r+1}{c+1} - \frac{1}{2}\right) + \frac{3}{2} C''_{\substack{\cancel{Lh}\\ L\alpha}}\right]$$

$$A_{33} = -\left(\frac{1-c}{2}\right)^4 \left(C'_{M\alpha} + \frac{1}{4} C'_{Lh} + \frac{1}{2} C'_{L\alpha} + \frac{1}{2} C'_{Mh}\right)$$

All of the aerodynamic flutter coefficients (i.e., all of the C, C' and C" coefficients) are obtained from Table 1208-2, in which values of the coefficients are tabulated with Mach number (M) and the frequency parameter (Ω) as independent parameters, where the latter is a function of M, V, ω, and b (see the symbols list). In the case of the C-coefficients, b is the semi-chord of the entire wing; for the C'-coefficients, b is the semi-chord of the aileron; and for the C"-coefficients, b is the semi-chord of that portion of the wing forward of the aileron. For any given wing-aileron combination it is assumed for flutter analyses that the circular frequency ω is the same for all primed or umprimed C-coefficients.

It should be noted that if the aileron flutter alone (with no wing-torsion or bending) is being investigated, the two families of curves in Figures 1201-4 and 1201-5 apply, if the aileron is assumed to be hinged at the leading edge (i.e., r = -1.0).

1207 Solution of Higher Order (above second order) Determinantal Flutter Equations

If, in the ternary flutter determinantal equations of motion (e.g., Equations 1205-2 and 1206-1), it is assumed that the frequencies bear a fixed ratio to each other, and that structural damping factors are equal, we may write:

$$Z = \left(\frac{\omega_\alpha}{\omega}\right)^2$$

$$g = g_h = g_\alpha = g_\beta \qquad (1207\text{-}1)$$

$$\Lambda = Z\,(1 + ig)$$

It is then found that the ternary determinantal equations may be put in the form of a third degree polynomial such as

$$\Delta_o\Lambda^3 + \Delta_1\Lambda^2 + \Delta_2\Lambda + \Delta_3 = 0 \qquad (1207\text{-}2)$$

Since, in supersonic flutter analyses it is necessary to solve the determinantal equation for each Mach number of interest, it is obvious that considerable computational work is required. Three methods of solving these higher-order flutter equations (including quadric as well as cubic equations) have been investigated by Ruggiero and recorded in Reference 12-17.

As an alternative to solving the cubic equation, one may assume that the bending and aileron frequencies are fixed quantities instead of being in fixed ratios with the torsional frequency. Then, on expanding the determinant, the stability equation will be linear in Λ and the torsional frequency may be found directly. After plotting ω_α and g_α versus $1/k$ or some other parameter, it will be found that at some value of k the calculated ω_α will be the same as the actual natural frequency. Thus, the torsional damping factor found at that value of k will determine the stability of the system.

Other modifications of the method may be made, for instance: (1) assume the aileron natural frequency known, and the value of k_α known, and then solve the resulting quadratic in Λ ; (2) assume that the damping is zero, the aileron natural frequency known, and then solve for Z and k_α . These methods may also be applied in principle to the binary equations discussed in Subsection 1204.

1208 Tables

1208.1 Reduced Frequency (k); Mach Number (M) and Frequency Parameter (Ω) Independent

Ω \ M	1.1	1.2	1.3	1.4	1.5	1.6
.01	.0008678	.001528	.002041	.002449	.002778	.003047
.02	.001736	.003056	.004083	.004898	.005556	.006094
.03	.002603	.004583	.006124	.007347	.008333	.009141
.04	.003471	.006111	.008166	.009796	.01111	.01219
.06	.005207	.009167	.01225	.01469	.01667	.01828
.08	.006942	.01222	.01633	.01959	.02222	.02438
.10	.008678	.01528	.02041	.02449	.02778	.03047
.15	.01302	.02292	.03062	.03673	.04167	.04570
.20	.01736	.03056	.04083	.04898	.05556	.06094
.25	.02169	.03819	.05104	.06122	.06944	.07617
.30	.02603	.04583	.06124	.07347	.08333	.09141
.35	.03037	.05347	.07145	.08571	.09722	.1066
.40	.03471	.06111	.08166	.09796	.1111	.1219
.50	.04339	.07639	.1021	.1224	.1389	.1523
.60	.05207	.09167	.1225	.1469	.1667	.1828
.70	.06074	.1069	.1429	.1714	.1944	.2133
.80	.06942	.1222	.1633	.1959	.2222	.2438
.90	.07810	.1375	.1837	.2204	.2500	.2742
1.0	.08678	.1528	.2041	.2449	.2778	.3047
1.2	.1041	.1833	.2450	.2939	.3333	.3656
1.4	.1215	.2139	.2858	.3429	.3889	.4266
1.6	.1388	.2444	.3266	.3918	.4444	.4875
1.8	.1562	.2750	.3675	.4408	.5000	.5484
2.0	.1736	.3056	.4083	.4898	.5556	.6094
2.2	.1909	.3361	.4491	.5388	.6111	.6703
2.4	.2083	.3667	.4899	.5878	.6667	.7313
2.6	.2256	.3972	.5308	.6367	.7222	.7922
2.8	.2430	.4278	.5716	.6857	.7778	.8531
3.0	.2603	.4583	.6124	.7347	.8333	.9141
3.5	.3037	.5347	.7145	.8571	.9722	1.0664
4.0	.3471	.6111	.8166	.9796	1.1111	1.2188
4.5	.3905	.6875	.9186	1.1020	1.2500	1.3711
5.0	.4339	.7639	1.0207	1.2245	1.3889	1.5234
7.5	.6508	1.1458	1.5311	1.8367	2.0833	2.2852
10.0	.8678	1.5278	2.0414	2.4490	2.7778	3.0469
15.0	1.3017	2.2917	3.0621	3.6735	4.1667	4.5703
20.0	1.7355	3.0556	4.0828	4.8980	5.5556	6.0938

Table 1208.1 REDUCED FREQUENCY (k); MACH NUMBER (M) AND FREQUENCY PARAMETER (Ω) INDEPENDENT

Ω \ M	1.7	1.8	1.9	2.0	2.2	2.4
.01	.003270	.003457	.003615	.003750	.003967	.004132
.02	.006540	.006914	.007230	.007500	.007934	.008264
.03	.009810	.01037	.01084	.01125	.01190	.01240
.04	.01308	.01383	.01446	.01500	.01587	.01653
.06	.01962	.02074	.02169	.02250	.02380	.02479
.08	.02616	.02765	.02892	.03000	.03174	.03306
.10	.03270	.03457	.03615	.03750	.03967	.04132
.15	.04905	.05185	.05422	.05625	.05950	.06198
.20	.06540	.06914	.07230	.07500	.07934	.08264
.25	.08175	.08642	.09037	.09375	.09917	.1033
.30	.09810	.1037	.1084	.1125	.1190	.1240
.35	.1144	.1210	.1265	.1312	.1388	.1446
.40	.1308	.1383	.1446	.1500	.1587	.1653
.50	.1635	.1728	.1807	.1875	.1983	.2066
.60	.1962	.2074	.2169	.2250	.2380	.2479
.70	.2289	.2420	.2530	.2625	.2777	.2892
.80	.2616	.2765	.2892	.3000	.3174	.3306
.90	.2943	.3111	.3253	.3375	.3570	.3719
1.0	.3270	.3457	.3615	.3750	.3967	.4132
1.2	.3924	.4148	.4338	.4500	.4760	.4958
1.4	.4578	.4840	.5061	.5250	.5554	.5785
1.6	.5232	.5531	.5784	.6000	.6347	.6611
1.8	.5886	.6222	.6507	.6750	.7140	.7437
2.0	.6540	.6914	.7230	.7500	.7934	.8264
2.2	.7194	.7605	.7953	.8250	.8727	.9090
2.4	.7848	.8296	.8676	.9000	.9521	.9917
2.6	.8502	.8988	.9399	.9750	1.0314	1.0743
2.8	.9156	.9679	1.0122	1.0500	1.1107	1.1569
3.0	.9810	1.0370	1.0845	1.1250	1.1901	1.2396
3.5	1.1445	1.2099	1.2652	1.3125	1.3884	1.4462
4.0	1.3080	1.3827	1.4460	1.5000	1.5868	1.6528
4.5	1.4715	1.5556	1.6267	1.6875	1.7851	1.8594
5.0	1.6350	1.7284	1.8075	1.8750	1.9835	2.0660
7.5	2.4524	2.5926	2.7112	2.8125	2.9752	3.0990
10.0	3.2699	3.4568	3.6150	3.7500	3.9669	4.1319
15.0	4.9048	5.1852	5.4224	5.6250	5.9504	6.1979
20.0	6.5398	6.9136	7.2299	7.5000	7.9339	8.2639

Table 1208.1 REDUCED FREQUENCY (k); MACH NUMBER (M) AND FREQUENCY PARAMETER (Ω) INDEPENDENT (Continued)

Ω \ M	2.6	2.8	3.0	3.2	3.4	3.6
.01	.004260	.004362	.004444	.004512	.004567	.004614
.02	.008521	.008724	.008889	.009023	.009135	.009228
.03	.01278	.01309	.01333	.01354	.01370	.01384
.04	.01704	.01745	.01778	.01805	.01827	.01846
.06	.02556	.02617	.02667	.02707	.02740	.02769
.08	.03408	.03490	.03556	.03609	.03654	.03691
.10	.04260	.04362	.04444	.04512	.04567	.04614
.15	.06391	.06543	.06667	.06768	.06851	.06921
.20	.08521	.08724	.08889	.09023	.09135	.09228
.25	.1065	.1091	.1111	.1128	.1142	.1154
.30	.1278	.1309	.1333	.1354	.1370	.1384
.35	.1491	.1527	.1556	.1579	.1599	.1615
.40	.1704	.1745	.1778	.1805	.1827	.1846
.50	.2130	.2181	.2222	.2256	.2284	.2307
.60	.2556	.2617	.2667	.2707	.2740	.2769
.70	.2982	.3054	.3111	.3158	.3197	.3230
.80	.3408	.3490	.3556	.3609	.3654	.3691
.90	.3834	.3926	.4000	.4061	.4111	.4153
1.0	.4260	.4362	.4444	.4512	.4567	.4614
1.2	.5112	.5235	.5333	.5414	.5481	.5537
1.4	.5964	.6107	.6222	.6316	.6394	.6460
1.6	.6817	.6980	.7111	.7219	.7308	.7383
1.8	.7669	.7852	.8000	.8121	.8221	.8306
2.0	.8521	.8724	.8889	.9023	.9135	.9228
2.2	.9373	.9597	.9778	.9926	1.0048	1.0151
2.4	1.0225	1.0469	1.0667	1.0828	1.0962	1.1074
2.6	1.1077	1.1342	1.1556	1.1730	1.1875	1.1997
2.8	1.1929	1.2214	1.2444	1.2633	1.2789	1.2920
3.0	1.2781	1.3087	1.3333	1.3535	1.3702	1.3843
3.5	1.4911	1.5268	1.5556	1.5791	1.5986	1.6150
4.0	1.7041	1.7449	1.7778	1.8047	1.8270	1.8457
4.5	1.9172	1.9630	2.0000	2.0303	2.0554	2.0764
5.0	2.1302	2.1811	2.2222	2.2559	2.2837	2.3071
7.5	3.1953	3.2717	3.3333	3.3838	3.4256	3.4606
10.0	4.2604	4.3622	4.4444	4.5117	4.5675	4.6142
15.0	6.3905	6.5434	6.6667	6.7676	6.8512	6.9213
20.0	8.5207	8.7245	8.8889	9.0234	9.1349	9.2284

Table 1208.1 REDUCED FREQUENCY (k); MACH NUMBER (M) AND FREQUENCY PARAMETER (Ω) INDEPENDENT (Continued)

Ω \ M	3.8	4.0	4.5	5.0	6.0	7.0
.01	.004654	.004688	.004753	.004800	.004861	.004898
.02	.009307	.009375	.009506	.009600	.009722	.009796
.03	.01396	.01406	.01426	.01440	.01458	.01469
.04	.01861	.01875	.01901	.01920	.01944	.01959
.06	.02792	.02812	.02852	.02880	.02917	.02939
.08	.03723	.03750	.03802	.03840	.03889	.03918
.10	.04654	.04688	.04753	.04800	.04861	.04898
.15	.06981	.07031	.07130	.07200	.07292	.07347
.20	.09307	.09375	.09506	.09600	.09722	.09796
.25	.1163	.1172	.1188	.1200	.1215	.1224
.30	.1396	.1406	.1426	.1440	.1458	.1469
.35	.1629	.1641	.1664	.1680	.1701	.1714
.40	.1861	.1875	.1901	.1920	.1944	.1959
.50	.2327	.2344	.2377	.2400	.2431	.2449
.60	.2792	.2812	.2852	.2880	.2917	.2939
.70	.3258	.3281	.3327	.3360	.3403	.3429
.80	.3723	.3750	.3802	.3840	.3889	.3918
.90	.4188	.4219	.4278	.4320	.4375	.4408
1.0	.4654	.4688	.4753	.4800	.4861	.4898
1.2	.5584	.5625	.5704	.5760	.5833	.5878
1.4	.6515	.6562	.6654	.6720	.6806	.6857
1.6	.7446	.7500	.7605	.7680	.7778	.7837
1.8	.8377	.8438	.8556	.8640	.8750	.8816
2.0	.9307	.9375	.9506	.9600	.9722	.9796
2.2	1.0238	1.0312	1.0457	1.0560	1.0694	1.0776
2.4	1.1169	1.1250	1.1407	1.1520	1.1667	1.1755
2.6	1.2100	1.2188	1.2358	1.2480	1.2639	1.2735
2.8	1.3030	1.3125	1.3309	1.3440	1.3611	1.3714
3.0	1.3961	1.4062	1.4259	1.4400	1.4583	1.4694
3.5	1.6288	1.6406	1.6636	1.6800	1.7014	1.7143
4.0	1.8615	1.8750	1.9012	1.9200	1.9444	1.9592
4.5	2.0942	2.1094	2.1389	2.1600	2.1875	2.2041
5.0	2.3269	2.3438	2.3765	2.4000	2.4306	2.4490
7.5	3.4903	3.5156	3.5648	3.6000	3.6458	3.6735
10.0	4.6537	4.6875	4.7531	4.8000	4.8611	4.8980
15.0	6.9806	7.0312	7.1296	7.2000	7.2917	7.3469
20.0	9.3075	9.3750	9.5062	9.6000	9.7222	9.7959

Table 1208.1 REDUCED FREQUENCY (k); MACH NUMBER (M) AND FREQUENCY PARAMETER (Ω) INDEPENDENT (Continued)

Ω \ M	8.0	9.0	10.0	11.0	12.0
.01	.004922	.004938	.004950	.004959	.004965
.02	.009844	.009877	.009900	.009917	.009931
.03	.01477	.01481	.01485	.01488	.01490
.04	.01969	.01975	.01980	.01983	.01986
.06	.02953	.02963	.02970	.02975	.02979
.08	.03938	.03951	.03960	.03967	.03972
.10	.04922	.04938	.04950	.04959	.04965
.15	.07383	.07407	.07425	.07438	.07448
.20	.09844	.09877	.09900	.09917	.09931
.25	.1230	.1235	.1238	.1240	.1241
.30	.1477	.1481	.1485	.1488	.1490
.35	.1723	.1728	.1732	.1736	.1738
.40	.1969	.1975	.1980	.1983	.1986
.50	.2461	.2469	.2475	.2479	.2483
.60	.2953	.2963	.2970	.2975	.2979
.70	.3445	.3457	.3465	.3471	.3476
.80	.3938	.3951	.3960	.3967	.3972
.90	.4430	.4444	.4455	.4463	.4469
1.0	.4922	.4938	.4950	.4959	.4965
1.2	.5906	.5926	.5940	.5950	.5958
1.4	.6891	.6914	.6930	.6942	.6951
1.6	.7875	.7901	.7920	.7934	.7944
1.8	.8859	.8889	.8910	.8926	.8938
2.0	.9844	.9877	.9900	.9917	.9931
2.2	1.0828	1.0864	1.0890	1.0909	1.0924
2.4	1.1812	1.1852	1.1880	1.1901	1.1917
2.6	1.2797	1.2840	1.2870	1.2893	1.2910
2.8	1.3781	1.3827	1.3860	1.3884	1.3903
3.0	1.4766	1.4815	1.4850	1.4876	1.4896
3.5	1.7227	1.7284	1.7325	1.7355	1.7378
4.0	1.9688	1.9753	1.9800	1.9835	1.9861
4.5	2.2148	2.2222	2.2275	2.2314	2.2344
5.0	2.4609	2.4691	2.4750	2.4793	2.4826
7.5	3.6914	3.7037	3.7125	3.7190	3.7240
10.0	4.9219	4.9383	4.9500	4.9587	4.9653
15.0	7.3828	7.4074	7.4250	7.4380	7.4479
20.0	9.8438	9.8765	9.9000	9.9174	9.9306

Table 1208.1 REDUCED FREQUENCY (k); MACH NUMBER (M) AND FREQUENCY PARAMETER (Ω) INDEPENDENT (Concluded)

1208.2 Aerodynamic Force Flutter Coefficient (C_L) and Moment Flutter Coefficient (C_M); Mach Number (M) and Frequency Parameter (Ω) Independent

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-13.230384	-3201.7511	-3689639.2	13645.534
00.02	-13.229586	-1600.7763	-922354.28	6822.3069
00.03	-13.228255	-1067.0740	-409894.12	4547.6937
00.04	-13.226393	-800.18976	-230533.07	3410.2338
00.06	-13.221075	-533.23948	-102418.04	2272.4677
00.08	-13.213632	-399.69839	-57577.808	1703.2787
00.10	-13.204068	-319.52109	-36823.209	1361.5210
00.15	-13.170914	-212.46519	-16324.934	905.13392
00.20	-13.124631	-158.77492	-9150.6754	676.18448
00.25	-13.065353	-126.43275	-5830.1692	538.21654
00.30	-12.993252	-104.76660	-4026.5964	445.74623
00.35	-12.908534	-89.203081	-2939.2635	379.28172
00.40	-12.811441	-77.455800	-2233.7110	329.07816
00.50	-12.581274	-60.838321	-1404.4467	257.96834
00.60	-12.305362	-49.582397	-954.59078	209.69018
00.70	-11.986806	-41.405253	-683.96024	174.51211
00.80	-11.629148	-35.167211	-508.92920	147.57487
00.90	-11.236315	-30.236357	-389.53998	126.18393
01.00	-10.812550	-26.234390	-304.74015	108.72628
01.20	-9.8903988	-20.136500	-195.85981	81.858475
01.40	-8.9004278	-15.741986	-132.11998	62.157454
01.60	-7.8809733	-12.482002	-92.486217	47.218434
01.80	-6.8687429	-10.033138	-66.841928	35.692177
02.00	-5.8968061	-8.1912825	-49.803563	26.745091
02.20	-4.9929471	-6.8152553	-38.274943	19.816011
02.40	-4.1784821	-5.7996530	-30.364694	14.497131
02.60	-3.4676029	-5.0612090	-24.863161	10.472482
02.80	-2.8672627	-4.5318519	-20.970915	7.4852195
03.00	-2.3775735	-4.1552012	-18.148862	5.3201039
03.50	-1.5873002	-3.5989150	-13.654828	2.3705981
04.00	-1.2441897	-3.2394224	-10.755628	1.3358581
04.50	-1.1042605	-2.8701682	-8.4652057	.94062682
05.00	-.98667714	-2.4774957	-6.6211552	.60910356
07.50	-.32115086	-1.5557492	-2.8987917	-.44170386
10.00	- .1237239	- 1.125767	- 1.605197	- .5143966
15.00	- .0107663	- .7881309	- .7314905	- .3879919
20.00	.0303910	- .6165438	- .4195301	- .3064455

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS, Lift, M = 1.1

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-11.025249	-1600.8425	-1844783.7	10837.563
00.02	-11.024371	-800.32202	-461141.23	5418.2808
00.03	-11.022908	-533.43778	-204911.15	3611.6306
00.04	-11.020859	-399.96261	-115230.63	2708.1387
00.06	-11.015009	-266.42141	-51173.135	1804.3132
00.08	-11.006823	-199.58489	-28753.037	1352.0673
00.10	-10.996305	-159.43037	-18375.762	1080.4538
00.15	-10.959846	-105.73845	-8126.7113	717.52958
00.20	-10.908967	-78.730676	-4539.7030	535.24539
00.25	-10.843829	-62.398714	-2879.6049	425.22499
00.30	-10.764640	-51.406958	-1978.0071	351.34478
00.35	-10.671649	-43.469131	-1434.5624	298.12474
00.40	-10.565151	-37.442446	-1082.0406	257.82613
00.50	-10.313020	-28.838257	-668.01234	200.52073
00.60	-10.011405	-22.931509	-443.80998	161.38517
00.70	-9.6640557	-18.583550	-309.33476	132.69655
00.80	-9.2752448	-15.226970	-222.76547	110.60116
00.90	-8.8496963	-12.547901	-164.11401	92.963917
01.00	-8.3925056	-10.358909	-122.84417	78.508041
01.20	-7.4049179	-7.0157488	-70.881517	56.173731
01.40	-6.3573437	-4.6374155	-41.702516	39.794205
01.60	-5.2948914	-2.9386642	-24.695739	27.466228
01.80	-4.2601331	-1.7508238	-14.710288	18.112525
02.00	-3.2906325	-.95953772	-8.9679793	11.053999
02.20	-2.4169609	-.47773352	-5.8444607	5.8182182
02.40	-1.6613287	-.23343717	-4.3310327	2.0470129
02.60	-1.0369064	-.16446150	-3.7752052	-.54990459
02.80	-.54784694	-.21643239	-3.7459640	-2.2183030
03.00	-.18996070	-.34240359	-3.9587652	-3.1707866
03.50	.21803870	-.74330013	-4.5231124	-3.5662202
04.00	.17881652	-.99082933	-4.4061296	-2.7457974
04.50	.01088480	-.98295344	-3.6769270	-1.9295279
05.00	-.07555973	-.81254342	-2.7964271	-1.5435642
07.50	.18721982	-.62059449	-1.4563338	-1.2655043
10.00	.1841614	- .4687929	- .8346054	- .9212357
15.00	.1152396	- .3918677	- .4037820	- .5294715
20.00	.0946744	- .3276093	- .2348771	- .3839792

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.1

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-4.3623711	-1256.3656	-822349.15	2227.1765
00.02	-4.3621151	-628.15011	-205577.13	1113.5045
00.03	-4.3616885	-418.73039	-91360.085	742.24323
00.04	-4.3610914	-314.00963	-51384.122	556.58470
00.06	-4.3593855	-209.26710	-22829.865	370.87039
00.08	-4.3569984	-156.87408	-12835.879	277.95750
00.10	-4.3539310	-125.42090	-8210.0959	222.16525
00.15	-4.3432957	-83.432911	-3641.4378	147.64621
00.20	-4.3284463	-62.385333	-2042.4323	110.24892
00.25	-4.3094224	-49.714493	-1302.3482	87.701481
00.30	-4.2862751	-41.232633	-900.35570	72.580172
00.35	-4.2590661	-35.145111	-657.99650	61.703627
00.40	-4.2278679	-30.554700	-500.72632	53.481352
00.50	-4.1538453	-24.071121	-315.86026	41.819354
00.60	-4.0649891	-19.689355	-215.54868	33.885040
00.70	-3.9622298	-16.513319	-155.17534	28.090274
00.80	-3.8466332	-14.095522	-116.10226	23.642160
00.90	-3.7193840	-12.187764	-89.424296	20.101111
01.00	-3.5817679	-10.641413	-70.449967	17.204053
01.20	-3.2809711	-8.2869016	-46.020363	12.730197
01.40	-2.9558142	-6.5875505	-31.637984	9.4362106
01.60	-2.6182053	-5.3205783	-22.620836	6.9306980
01.80	-2.2797392	-4.3602800	-16.720089	4.9942693
02.00	-1.9510969	-3.6283906	-12.741310	3.4913816
02.20	-1.6415349	-3.0717807	-9.9991087	2.3306152
02.40	-1.3584932	-2.6515900	-8.0756663	1.4452234
02.60	-1.1073445	-2.3376574	-6.7040440	.78309112
02.80	-.89129264	-2.1055951	-5.7076406	.30141271
03.00	-.71141724	-1.9352429	-4.9668330	-.03613290
03.50	-.41033542	-1.6767366	-3.7558400	-.44435327
04.00	-.27450741	-1.5224688	-2.9792883	-.51342939
04.50	-.22737632	-1.3818788	-2.3842118	-.47679891
05.00	-.20282627	-1.2333557	-1.9076430	-.44601913
07.50	-.00835777	-.81740877	-.86346896	-.41953861
10.00	.0208292	- .6266432	- .4851438	- .3256125
15.00	.0246040	- .4580355	- .2186748	- .2120162
20.00	.0106292	- .3535049	- .1172607	- .1611712

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.2

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-3.6352865	-628.17192	-411168.16	1646.5687
00.02	-3.6350049	-314.05324	-102782.15	823.19382
00.03	-3.6345357	-209.33248	-45673.632	548.69531
00.04	-3.6338788	-156.96120	-25685.651	411.41591
00.06	-3.6320025	-104.56815	-11408.525	274.07623
00.08	-3.6293769	-78.349883	-6411.5360	205.34618
00.10	-3.6260033	-62.601572	-4098.6488	164.06008
00.15	-3.6143080	-41.553484	-1814.3352	108.87227
00.20	-3.5979831	-30.976014	-1014.8539	81.129746
00.25	-3.5770769	-24.587459	-644.83936	64.366701
00.30	-3.5516512	-20.294075	-443.87667	53.094852
00.35	-3.5217808	-17.198670	-322.73650	44.962342
00.40	-3.4875537	-14.852759	-244.14665	38.793471
00.50	-3.4064432	-11.512863	-151.82107	29.996112
00.60	-3.3092660	-9.2290597	-101.79445	23.961876
00.70	-3.1971474	-7.5541714	-71.757437	19.517862
00.80	-3.0713737	-6.2652287	-52.389612	16.079003
00.90	-2.9333715	-5.2388094	-39.236818	13.321315
01.00	-2.7846859	-4.4011666	-29.951576	11.051192
01.20	-2.4618894	-3.1208924	-18.180324	7.5242244
01.40	-2.1167671	-2.2043701	-11.472327	4.9223998
01.60	-1.7633719	-1.5404365	-7.4701069	2.9581355
01.80	-1.4152141	-1.0645887	-5.0329160	1.4686191
02.00	-1.0845194	-.73436399	-3.5481350	.35079364
02.20	-.78160860	-.51849048	-2.6592857	-.46772714
02.40	-.51443591	-.39183199	-2.1458539	-1.0426573
02.60	-.28831215	-.33302799	-1.8653392	-1.4200127
02.80	-.10582239	-.32346654	-1.7232056	-1.6395617
03.00	.03306768	-.34692692	-1.6562446	-1.7364274
03.50	.20978939	-.46500281	-1.5805181	-1.6364354
04.00	.21346833	-.55984547	-1.4427918	-1.3322255
04.50	.14682983	-.57435074	-1.2143988	-1.0479029
05.00	.09024193	-.52181857	-.96531909	-.86897249
07.50	.14173627	-.39057610	-.47897499	-.58810046
10.00	.0958066	- .3146644	- .2658983	- .4143608
15.00	.0434087	- .2567556	- .1176150	- .2525307
20.00	.0121974	- .1958124	- .0566831	- .1911216

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.2

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-2.2214072	-750.83889	-367802.61	712.74258
00.02	-2.2212797	-375.40278	-91946.849	356.34006
00.03	-2.2210672	-250.25001	-40862.450	237.52535
00.04	-2.2207698	-187.66808	-22982.910	178.10759
00.06	-2.2199201	-125.07505	-10211.812	118.66903
00.08	-2.2187311	-93.767460	-5741.9287	88.928971
00.10	-2.2172032	-74.974061	-3673.0131	71.068344
00.15	-2.2119050	-49.890508	-1629.6458	47.205935
00.20	-2.2045063	-37.321421	-914.47631	35.223358
00.25	-2.1950257	-29.758399	-583.46497	27.993126
00.30	-2.1834870	-24.698704	-403.66685	23.139503
00.35	-2.1699192	-21.069790	-295.26514	19.644399
00.40	-2.1543562	-18.335428	-224.91941	16.998837
00.50	-2.1174049	-14.478085	-142.22366	13.238650
00.60	-2.0730002	-11.875959	-97.342883	10.672063
00.70	-2.0215798	-9.9933854	-70.322291	8.7909565
00.80	-1.9636462	-8.5628050	-52.826095	7.3417046
00.90	-1.8997592	-7.4357800	-40.871604	6.1837379
01.00	-1.8305284	-6.5233969	-32.360732	5.2329703
01.20	-1.6786708	-5.1355194	-21.380744	3.7576394
01.40	-1.5136127	-4.1333075	-14.889759	2.6653426
01.60	-1.3411129	-3.3837158	-10.795710	1.8313197
01.80	-1.1668529	-2.8120406	-8.0947340	1.1856859
02.00	-.99615730	-2.3722072	-6.2544049	.68521109
02.20	-.83374906	-2.0333713	-4.9697378	.30060398
02.40	-.68355352	-1.7733445	-4.0551278	.01029229
02.60	-.54856116	-1.5751798	-3.3921174	-.20277960
02.80	-.43075495	-1.4253396	-2.9023044	-.35283590
03.00	-.33110318	-1.3126978	-2.5324304	-.45214910
03.50	-.15939119	-1.1368984	-1.9179863	-.54582997
04.00	-.07896672	-1.0351272	-1.5249635	-.51945013
04.50	-.05352618	-.95096652	-1.2293456	-.45919898
05.00	-.04766825	-.86488806	-.99358926	-.40852096
07.50	.02886718	-.58771913	-.45031874	-.30543113
10.00	.0228895	- .4607107	- .2500911	- .2252936
15.00	.0099115	- .3284656	- .1083477	- .1488935
20.00	- .0030421	- .2452621	- .0562852	- .1151970

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.3

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-1.8511613	-375.41389	-183898.95	468.80549
00.02	-1.8510211	-187.69029	-45971.075	234.36923
00.03	-1.8507873	-125.10835	-20428.875	156.20891
00.04	-1.8504602	-93.811830	-11489.106	117.11759
00.06	-1.8495256	-62.504223	-5103.5573	78.003948
00.08	-1.8482178	-46.839347	-2868.6170	58.424833
00.10	-1.8465373	-37.431583	-1834.1608	46.659560
00.15	-1.8407110	-24.862250	-812.48277	30.920797
00.20	-1.8325769	-18.550349	-454.90589	22.996361
00.25	-1.8221576	-14.741745	-289.41028	18.198147
00.30	-1.8094820	-12.185134	-199.52346	14.963570
00.35	-1.7945853	-10.344305	-145.33701	12.623044
00.40	-1.7775086	-8.9512074	-110.18066	10.841860
00.50	-1.7370095	-6.9723044	-68.872041	8.2884139
00.60	-1.6884291	-5.6235273	-46.478872	6.5231109
00.70	-1.6322971	-4.6374687	-33.023320	5.2122597
00.80	-1.5692199	-3.8807339	-24.336987	4.1895200
00.90	-1.4998722	-3.2794436	-18.427964	3.3628701
01.00	-1.4249871	-2.7894311	-14.246590	2.6773884
01.20	-1.2617617	-2.0406138	-8.9195722	1.6026759
01.40	-1.0861513	-1.5025726	-5.8521013	.80263563
01.60	-.90496755	-1.1090919	-3.9922216	.19615382
01.80	-.72485424	-.82223308	-2.8320870	-.26277639
02.00	-.55194103	-.61755473	-2.0998541	-.60356406
02.20	-.39154430	-.47753801	-1.6379304	-.84728192
02.40	-.24793325	-.38846116	-1.3491472	-1.0106153
02.60	-.12417387	-.33887923	-1.1707951	-1.1077960
02.80	-.02205713	-.31890550	-1.0611712	-1.1515216
03.00	.05788828	-.31990680	-.99215591	-1.1533386
03.50	.16740814	-.36798675	-.88890925	-1.0407272
04.00	.17834098	-.41897150	-.78875733	-.86131161
04.50	.14062878	-.43350072	-.66432150	-.69800285
05.00	.09858141	-.40966604	-.53539164	-.58492155
07.50	.09532299	-.30114231	-.25241650	-.38239504
10.0	.0472991	- .2466296	- .1329916	- .2702918
15.00	.0109922	- .1828089	- .0533972	- .1758063
20.00	- .0068283	- .1293200	- .0240906	- .1368057

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.3

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-1.3536148	-530.62022	-216670.15	287.41257
00.02	-1.3535385	-265.29996	-54165.634	143.69070
00.03	-1.3534114	-176.85536	-24072.205	95.776492
00.04	-1.3532333	-132.62968	-13539.505	71.814195
00.06	-1.3527248	-88.397239	-6016.1489	47.841522
00.08	-1.3520131	-66.274268	-3382.9749	35.844820
00.10	-1.3510985	-52.995095	-2164.1922	28.638518
00.15	-1.3479269	-35.273872	-960.45937	19.006044
00.20	-1.3434973	-26.396608	-539.15736	14.164166
00.25	-1.3378203	-21.057089	-344.15963	11.238728
00.30	-1.3309094	-17.486615	-238.24012	9.2717208
00.35	-1.3227810	-14.927204	-174.37937	7.8526108
00.40	-1.3134544	-12.999891	-132.93679	6.7761634
00.50	-1.2912978	-10.283736	-84.215541	5.2409182
00.60	-1.2646484	-8.4541837	-57.769630	4.1874630
00.70	-1.2337556	-7.1326029	-41.843908	3.4109843
00.80	-1.1989061	-6.1298409	-31.527902	2.8092873
00.90	-1.1604202	-5.3409378	-24.475525	2.3257631
01.00	-1.1186473	-4.7030100	-19.450903	1.9265741
01.20	-1.0267571	-3.7336257	-12.958650	1.3026579
01.40	-.92643684	-3.0336305	-9.1086568	.83700524
01.60	-.82104256	-2.5090094	-6.6693753	.47961585
01.80	-.71392016	-2.1071458	-5.0502922	.20249230
02.00	-.60824853	-1.7958026	-3.9385572	-.01174288
02.20	-.50689887	-1.5536226	-3.1552101	-.17497203
02.40	-.41231819	-1.3654442	-2.5914939	-.29608328
02.60	-.32644300	-1.2198477	-2.1780661	-.38224980
02.80	-.25064682	-1.1078188	-1.8690307	-.43959356
03.00	-.18572281	-1.0220053	-1.6331545	-.47352089
03.50	-.07123204	-.88454366	-1.2369087	-.48646234
04.00	-.01581722	-.80530977	-.98372365	-.44398535
04.50	.00085726	-.74416291	-.79573601	-.38806575
05.00	.00078103	-.68424207	-.64644851	-.34096245
07.50	.02928896	-.47019468	-.28990222	-.23788142
10.00	.01394996	-.37052712	-.15844431	-.17359457
15.00	.00094680	-.25381483	-.06673173	-.11841317
20.00	-.00356114	-.18632963	-.03612292	-.09191458

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.4

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-1.1280056	-265.30673	-108333.92	151.07021
00.02	-1.1279216	-132.64321	-27081.661	75.518473
00.03	-1.1277817	-88.417529	-12034.947	50.327172
00.04	-1.1275859	-66.301307	-6768.5968	37.725981
00.06	-1.1270265	-44.178326	-3006.9190	25.113715
00.08	-1.1262437	-33.110088	-1690.3326	18.796520
00.10	-1.1252378	-26.463758	-1080.9421	14.997368
00.15	-1.1217500	-17.586350	-479.07841	9.9061578
00.20	-1.1168800	-13.131037	-268.43125	7.3332261
00.25	-1.1106406	-10.444751	-170.93731	5.7678438
00.30	-1.1030483	-8.6431797	-117.98356	4.7064903
00.35	-1.0941228	-7.3473694	-86.060241	3.9334175
00.40	-1.0838878	-6.3678738	-65.347052	3.3407911
00.50	-1.0595992	-4.9790551	-41.005681	2.4813631
00.60	-1.0304354	-4.0350118	-27.805896	1.8770170
00.70	-.99669806	-3.3466796	-19.869915	1.4204154
00.80	-.95873360	-2.8197115	-14.742260	1.0581378
00.90	-.91692804	-2.4018315	-11.249619	.76069880
01.00	-.87170181	-2.0617744	-8.7737605	.51055271
01.20	-.77280587	-1.5424575	-5.6079744	.11165594
01.40	-.66586915	-1.1685283	-3.7709477	-.19013712
01.60	-.55486832	-.89325619	-2.6440457	-.42042086
01.80	-.44372722	-.69009699	-1.9291373	-.59380208
02.00	-.33612159	-.54221895	-1.4670378	-.71985920
02.20	-.23530644	-.43781552	-1.1657402	-.80578438
02.40	-.14397595	-.36784736	-.96867186	-.85762302
02.60	-.06416338	-.32491502	-.83937640	-.88085307
02.80	.00281476	-.30269862	-.75358025	-.88062897
03.00	.05636888	-.29569506	-.69482377	-.86184821
03.50	.13370905	-.31497727	-.60160900	-.76310140
04.00	.14581938	-.34517768	-.52459808	-.63704841
04.50	.12133434	-.35687505	-.44118209	-.52402868
05.00	.08843185	-.34391747	-.35753965	-.44191668
07.50	.06319630	-.24825947	-.15995741	-.28681011
10.00	.02109569	-.20262879	-.08029582	-.20497933
15.00	-.00141549	-.13565939	-.03058936	-.14026191
20.00	-.00548052	-.09368797	-.01614275	-.10899009

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.4

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.91103918	-409.97067	-147589.59	122.98649
00.02	-.91098857	-204.97850	-36896.282	61.484137
00.03	-.91090422	-136.64474	-16397.521	40.979303
00.04	-.91078615	-102.47559	-9222.9548	30.723851
00.06	-.91044885	-68.301883	-4098.2649	20.462331
00.08	-.90997681	-51.210487	-2304.6239	15.325509
00.10	-.90937020	-40.952020	-1474.4247	12.238574
00.15	-.90726648	-27.263523	-654.47677	8.1085832
00.20	-.90432800	-20.408060	-367.49759	6.0285907
00.25	-.90056145	-16.285915	-234.67006	4.7687115
00.30	-.89597540	-13.530542	-162.51984	3.9190104
00.35	-.89058027	-11.556298	-119.01865	3.3038232
00.40	-.88438829	-10.070380	-90.787892	2.8353370
00.50	-.86967156	-7.9779797	-57.597344	2.1629156
00.60	-.85195776	-6.5703191	-39.579481	1.6970543
00.70	-.83140541	-5.5548126	-28.727074	1.3501818
00.80	-.80819699	-4.7852757	-21.695293	1.0786347
00.90	-.78253664	-4.1805782	-16.886095	.85825215
01.00	-.75464762	-3.6921047	-13.457688	.67461219
01.20	-.69315530	-2.9505849	-9.0226226	.38415321
01.40	-.62577891	-2.4153011	-6.3861966	.16458315
01.60	-.55469137	-2.0135985	-4.7099647	-.00525190
01.80	-.48207797	-1.7049054	-3.5921328	-.13719884
02.00	-.41003796	-1.4644828	-2.8200161	-.23866875
02.20	-.34049493	-1.2760688	-2.2720868	-.31482596
02.40	-.27512066	-1.1282399	-1.8745775	-.36964997
02.60	-.21527633	-1.0124927	-1.5804986	-.40647118
02.80	-.16197353	-.92218885	-1.3587547	-.42824008
03.00	-.11585627	-.85195830	-1.1881620	-.43765382
03.50	-.03300072	-.73681910	-.89917765	-.42299570
04.00	.00823318	-.66988211	-.71458699	-.37929624
04.50	.02032876	-.62049391	-.57887676	-.33015930
05.00	.01809028	-.57413687	-.47156736	-.28872736
07.50	.02317949	-.39617482	-.20835941	-.19556150
10.00	.00673163	-.31120791	-.11244837	-.14300283
15.00	-.00244295	-.20600366	-.04706389	-.09984772
20.00	-.00106506	-.15147290	-.02718624	-.07669007

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.5

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.75919482	-204.98306	-73794.128	34.158149
00.02	-.75913915	-102.48470	-18447.473	17.069395
00.03	-.75904637	-68.315540	-8198.0926	11.368842
00.04	-.75891648	-51.228686	-4610.8095	8.5153414
00.06	-.75854547	-34.137283	-2048.4648	5.6553945
00.08	-.75802627	-25.587040	-1151.6446	4.2189821
00.10	-.75735908	-20.453267	-736.54553	3.3519922
00.15	-.75504559	-13.597711	-326.57313	2.1810601
00.20	-.75181486	-10.158746	-183.08575	1.5796841
00.25	-.74767502	-8.0865417	-116.67483	1.2062662
00.30	-.74263648	-6.6978478	-80.603177	.94697207
00.35	-.73671186	-5.6998674	-58.856646	.75304199
00.40	-.72991601	-4.9462223	-44.745933	.60011891
00.50	-.71378064	-3.8792600	-28.161753	.36866759
00.60	-.69439094	-3.1556268	-19.166179	.19602736
00.70	-.67193871	-2.6291951	-13.755479	.05812600
00.80	-.64664442	-2.2270239	-10.257104	-.05692954
00.90	-.61875430	-1.9086838	-7.8718809	-.15563480
01.00	-.58853706	-1.6499855	-6.1787474	-.24180192
01.20	-.52228734	-1.2552722	-4.0077182	-.38514519
01.40	-.45035648	-.97073844	-2.7405334	-.49775786
01.60	-.37532319	-.76029098	-1.9563465	-.58488913
01.80	-.29975607	-.60355067	-1.4526186	-.64963987
02.00	-.22609099	-.48774573	-1.1214197	-.69430257
02.20	-.15652074	-.40406931	-.90051846	-.72093613
02.40	-.09290291	-.34590891	-.75174124	-.73161002
02.60	-.03669077	-.30794663	-.65052535	-.72848831
02.80	.01110977	-.28569710	-.58050910	-.71382984
03.00	.04995579	-.27527696	-.53055649	-.68994379
03.50	.10830586	-.27987979	-.44915004	-.60466318
04.00	.11992627	-.29799573	-.38672376	-.50772576
04.50	.10281039	-.30659762	-.32449446	-.42173616
05.00	.07627909	-.29843451	-.26361244	-.35738826
07.50	.04137499	-.21173948	-.11209472	-.23221417
10.00	.00714516	-.17062847	-.05442073	-.16814023
15.00	-.00481993	-.10556962	-.02094539	-.11848386
20.00	-.00114393	-.07459111	-.01345575	-.09053547

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.5

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.65345438	-334.57150	-109808.19	47.179697
00.02	-.65341852	-167.28085	-27451.325	23.583963
00.03	-.65335875	-111.51512	-12200.054	15.716104
00.04	-.65327509	-83.630624	-6862.1089	11.780213
00.06	-.65303608	-55.742865	-3049.2913	7.8404027
00.08	-.65270160	-41.795725	-1714.8054	5.8665816
00.10	-.65227174	-33.424838	-1097.1294	4.6791607
00.15	-.65078095	-22.256093	-487.08010	3.0868374
00.20	-.64869842	-16.663673	-273.56453	2.2809851
00.25	-.64602871	-13.301856	-174.73914	1.7897934
00.30	-.64277765	-11.055418	-121.05814	1.4560086
00.35	-.63895235	-9.4464220	-88.692180	1.2122507
00.40	-.63456113	-8.2359098	-67.687472	1.0248416
00.50	-.62412033	-6.5324710	-42.991594	.75176107
00.60	-.61154567	-5.3876659	-29.583969	.55831534
00.70	-.59694537	-4.5626904	-21.507165	.41098001
00.80	-.58044419	-3.9382192	-16.272617	.29307106
00.90	-.56218187	-3.4480199	-12.691393	.19538156
01.00	-.54231153	-3.0523982	-10.137216	.11243554
01.20	-.49841482	-2.4524088	-6.8299691	-.02184341
01.40	-.45017391	-2.0194957	-4.8602011	-.12580180
01.60	-.39909581	-1.6943441	-3.6043618	-.20732396
01.80	-.34670702	-1.4438827	-2.7637713	-.27083238
02.00	-.29448735	-1.2480161	-2.1804359	-.31915615
02.20	-.24380877	-1.0936134	-1.7641597	-.35436586
02.40	-.19588241	-.97152735	-1.4602479	-.37817198
02.60	-.15171638	-.87501613	-1.2338898	-.39211777
02.80	-.11208600	-.79886801	-1.0620571	-.39766716
03.00	-.07751766	-.73890171	-.92905178	-.39623596
03.50	-.01446114	-.63857184	-.70225117	-.37093040
04.00	.01766000	-.57940231	-.55736472	-.32950161
04.50	.02697331	-.53690947	-.45168337	-.28638596
05.00	.02397678	-.49851814	-.36849444	-.25001565
07.50	.01680484	-.34417128	-.16031215	-.16695127
10.00	.00218567	-.26844212	-.08593307	-.12290792
15.00	-.00298764	-.17381573	-.03639067	-.08675039
20.00	.00067444	-.12921516	-.02192133	-.06566161

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.6

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.54454213	-167.28412	-54903.668	-16.446929
00.02	-.54450268	-83.637157	-13725.235	-8.2296934
00.03	-.54443694	-55.752660	-6099.5997	-5.4933823
00.04	-.54434491	-41.808779	-3430.6273	-4.1273020
00.06	-.54408201	-27.861635	-1524.2187	-2.7653695
00.08	-.54371411	-20.884805	-856.97595	-2.0885467
00.10	-.54324133	-16.696106	-548.13823	-1.6857624
00.15	-.54160186	-11.103621	-243.11461	-1.1583353
00.20	-.53931217	-8.2993503	-136.35823	-.90486219
00.25	-.53637778	-6.6104515	-86.947344	-.76088519
00.30	-.53280577	-5.4793294	-60.109046	-.67156486
00.35	-.52860476	-4.6670316	-43.928660	-.61338190
00.40	-.52378486	-4.0540960	-33.429282	-.57456224
00.50	-.51233612	-3.1874422	-21.088420	-.53140908
00.60	-.49856907	-2.6007741	-14.393132	-.51447894
00.70	-.48261470	-2.1748056	-10.364629	-.51181693
00.80	-.46462375	-1.8499808	-7.7585442	-.51735435
00.90	-.44476485	-1.5932795	-5.9803173	-.52764806
01.00	-.42322235	-1.3849395	-4.7167073	-.54057714
01.20	-.37588876	-1.0673796	-3.0928672	-.56921469
01.40	-.32432162	-.83834110	-2.1407265	-.59647983
01.60	-.27031162	-.66836206	-1.5474879	-.61886299
01.80	-.21565637	-.54087803	-1.1627730	-.63451018
02.00	-.16207785	-.44559866	-.90657444	-.64256311
02.20	-.11114692	-.37552347	-.73285245	-.64283960
02.40	-.06421889	-.32548199	-.61342303	-.63564837
02.60	-.02238342	-.29138261	-.53017800	-.62166092
02.80	.01356901	-.26981799	-.47105568	-.60180929
03.00	.04316302	-.25786010	-.42782669	-.57719711
03.50	.08898274	-.25408081	-.35623323	-.50271488
04.00	.09961770	-.26439095	-.30363847	-.42398680
04.50	.08706459	-.27019635	-.25411956	-.35474175
05.00	.06523880	-.26424109	-.20665389	-.30188816
07.50	.02650529	-.18457393	-.08385794	-.19693121
10.00	.00001465	-.14625155	-.04014228	-.14441633
15.00	-.00462843	-.08641163	-.01635466	-.10288064
20.00	.00139123	-.06366423	-.01158598	-.07716180

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.6

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.49001520	-283.23146	-86617.957	8.2395430
00.02	-.48998858	-141.61206	-21653.989	4.1157011
00.03	-.48994421	-94.403954	-9623.6241	2.7392784
00.04	-.48988211	-70.798679	-5412.9966	2.0497108
00.06	-.48970470	-47.190957	-2405.4056	1.3574322
00.08	-.48945642	-35.384651	-1352.7489	1.0085844
00.10	-.48913734	-28.298916	-865.51950	.79711197
00.15	-.48803069	-18.845596	-384.30601	.50885712
00.20	-.48648465	-14.112899	-215.88243	.35802576
00.25	-.48450250	-11.268504	-137.92762	.26221267
00.30	-.48208843	-9.3683179	-95.583125	.19396083
00.35	-.47924751	-8.0077390	-70.052097	.14151254
00.40	-.47598573	-6.9844754	-53.482881	.09899721
00.50	-.46822786	-5.5453458	-34.001371	.03205630
00.60	-.45739789	-4.5790112	-23.421700	-.03557717
00.70	-.44801910	-3.8832925	-17.051260	-.06435160
00.80	-.43573572	-3.3571569	-12.920393	-.10241380
00.90	-.42213025	-2.9445195	-10.093494	-.13618726
01.00	-.40731311	-2.6117632	-8.0765653	-.16655620
01.20	-.37452677	-2.1075630	-5.4629868	-.21903198
01.40	-.33840570	-1.7439614	-3.9039523	-.26221697
01.60	-.30004733	-1.4707241	-2.9077602	-.29719760
01.80	-.26056999	-1.2598726	-2.2389708	-.32459538
02.00	-.22106610	-1.0944504	-1.7731119	-.34489248
02.20	-.18255830	-.96342819	-1.4391774	-.35857088
02.40	-.14596094	-.85917431	-1.1941457	-.36616990
02.60	-.11204853	-.77610987	-1.0106562	-.36830329
02.80	-.08143259	-.70995965	-.87061651	-.36565445
03.00	-.05454774	-.65732025	-.76168951	-.35895935
03.50	-.00488924	-.56767564	-.57494726	-.32953758
04.00	.02090676	-.51393244	-.45560705	-.29109962
04.50	.02835650	-.47590596	-.36912633	-.25293879
05.00	.02518664	-.44261440	-.30136649	-.22075235
07.50	.01152631	-.30516800	-.12923510	-.14638178
10.00	-.00036854	-.23598458	-.06920391	-.10863911
15.00	-.00240861	-.15123326	-.02992692	-.07673344
20.00	.00120876	-.11374445	-.01816890	-.05737442

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.7

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.40834363	-141.61451	-43308.686	-40.339967
00.02	-.40831435	-70.803578	-10826.701	-20.174277
00.03	-.40826555	-47.198302	-4811.5191	-13.454289
00.04	-.40819724	-35.394440	-2706.2054	-10.095725
00.06	-.40800210	-23.588132	-1202.4100	-6.7400203
00.08	-.40772900	-17.682534	-676.08185	-5.0650245
00.10	-.40737806	-14.137224	-432.46733	-4.0623084
00.15	-.40616103	-9.4044797	-191.86127	-2.7319851
00.20	-.40446117	-7.0320849	-107.65045	-2.0738844
00.25	-.40228245	-5.6038924	-68.674281	-1.6846148
00.30	-.39962995	-4.6478677	-47.503538	-1.4296988
00.35	-.39650984	-3.9617223	-34.739798	-1.2514919
00.40	-.39292937	-3.4443224	-26.457226	-1.1211620
00.50	-.38442163	-2.7135322	-16.721313	-.94643153
00.60	-.37492630	-2.2120761	-11.398073	-.83435169
00.70	-.36231476	-1.8616087	-8.2588688	-.76729661
00.80	-.34891822	-1.5890338	-6.2011002	-.71939692
00.90	-.33411726	-1.3739332	-4.7961393	-.68630205
01.00	-.31804490	-1.1995617	-3.7969188	-.66309774
01.20	-.28266614	-.93404920	-2.5105781	-.63476969
01.40	-.24401382	-.74252109	-1.7535788	-.61936919
01.60	-.20339330	-.60002330	-1.2793799	-.60928291
01.80	-.16212359	-.49256868	-.96955659	-.60033334
02.00	-.12147886	-.41152559	-.76118323	-.59017464
02.20	-.08263419	-.35108458	-.61810946	-.57755130
02.40	-.04661852	-.30701361	-.51824410	-.56191147
02.60	-.01427699	-.27601160	-.44741331	-.54318036
02.80	.01375558	-.25536333	-.39617928	-.52161188
03.00	.03706927	-.24275492	-.35809285	-.49768141
03.50	.07403910	-.23386598	-.29431157	-.43170352
04.00	.08358662	-.23881709	-.24873644	-.36539962
04.50	.07405703	-.24223824	-.20760811	-.30750784
05.00	.05583237	-.23726721	-.16889055	-.26269708
07.50	.01632606	-.16348620	-.06576423	-.17216620
10.00	-.00333346	-.12723276	-.03162176	-.12769546
15.00	-.00331513	-.07400874	-.01386604	-.09080760
20.00	.00198499	-.05655485	-.00977743	-.06719145

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.7

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.37977843	-246.09894	-71192.971	-13.185946
00.02	-.37975798	-123.04662	-17797.878	-6.5959315
00.03	-.37972389	-82.027917	-7909.8982	-4.4005746
00.04	-.37967617	-61.517616	-4449.1052	-3.3038819
00.06	-.37953985	-41.005417	-1977.1102	-2.2091597
00.08	-.37934908	-30.747424	-1111.9121	-1.6637673
00.10	-.37910390	-24.591114	-711.44917	-1.3381046
00.15	-.37825352	-16.378305	-315.93075	-.90846104
00.20	-.37706544	-12.267219	-177.50013	-.69851284
00.25	-.37554209	-9.7968640	-113.42743	-.57640785
00.30	-.37368658	-8.1469174	-78.623464	-.49818723
00.35	-.37150272	-6.9658206	-57.638758	-.44500457
00.40	-.36899497	-6.0778013	-44.019890	-.40743079
00.50	-.36302885	-4.8294765	-28.006911	-.36022872
00.60	-.35583666	-3.9918801	-19.312189	-.33451628
00.70	-.34747651	-3.3893257	-14.073311	-.32078915
00.80	-.33801546	-2.9340134	-10.676866	-.31425663
00.90	-.32752884	-2.5772000	-8.3520464	-.31222643
01.00	-.31609940	-2.2896655	-6.6928383	-.31305893
01.20	-.29077454	-1.8543402	-4.5414665	-.31940436
01.40	-.26281501	-1.5405839	-3.2565172	-.32816927
01.60	-.23304980	-1.3047285	-2.4339584	-.33671240
01.80	-.20232803	-1.1224718	-1.8803851	-.34357227
02.00	-.17148448	-.97911378	-1.4935949	-.34794365
02.20	-.14130700	-.86512734	-1.2153217	-.34943384
02.40	-.11250745	-.77395549	-1.0102882	-.34793278
02.60	-.08569747	-.70083797	-.85607458	-.34353371
02.80	-.06137013	-.64215442	-.73786196	-.33647781
03.00	-.03988800	-.59504339	-.64554408	-.32711111
03.50	.00020713	-.51356713	-.48656538	-.29639144
04.00	.02138163	-.46390154	-.38491463	-.26088904
04.50	.02749823	-.42900421	-.31165775	-.22676876
05.00	.02440888	-.39920344	-.25452654	-.19800778
07.50	.00747162	-.27463019	-.10779498	-.13086614
10.00	-.00164645	-.21052197	-.05792872	-.09789305
15.00	-.00155118	-.13471101	-.02562395	-.06874835
20.00	.00100945	-.10213041	-.01528985	-.05102601

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.8

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.31648021	-123.04852	-35596.274	-52.005526
00.02	-.31645771	-61.521412	-8898.7278	-26.005875
00.03	-.31642021	-41.011111	-3954.7378	-17.340707
00.04	-.31636772	-30.755011	-2224.3413	-13.009160
00.06	-.31621778	-20.497015	-988.34389	-8.6796858
00.08	-.31600794	-15.366123	-555.74496	-6.5170188
00.10	-.31573828	-12.286075	-355.51362	-5.2210722
00.15	-.31480308	-8.1749541	-157.75490	-3.4979501
00.20	-.31349677	-6.1147240	-88.540287	-2.6415077
00.25	-.31182231	-4.8748977	-56.504828	-2.1316957
00.30	-.30978347	-4.0453238	-39.103928	-1.7951547
00.35	-.30738488	-3.4502323	-28.612851	-1.5575798
00.40	-.30463193	-3.0017462	-21.804883	-1.3818114
00.50	-.29808852	-2.3688666	-13.801880	-1.1413483
00.60	-.29021195	-1.9417228	-9.4587209	-.98698506
00.70	-.28107254	-1.6325367	-6.8441650	-.88147389
00.80	-.27075138	-1.3974688	-5.1514674	-.80614595
00.90	-.25933941	-1.2122023	-3.9951793	-.75059413
01.00	-.24693632	-1.0621762	-3.1722451	-.70854649
01.20	-.21959246	-.83396149	-2.1113280	-.65023789
01.40	-.18964711	-.66935296	-1.4851406	-.61218123
01.60	-.15808720	-.54665377	-1.0911757	-.58478343
01.80	-.12591555	-.45372953	-.83222720	-.56274394
02.00	-.09410771	-.38313008	-.65669858	-.54298961
02.20	-.06357162	-.32988397	-.53498912	-.52372800
02.40	-.03511204	-.29041106	-.44903754	-.50396329
02.60	-.00940140	-.26195406	-.38727059	-.48322325
02.80	.01304149	-.24227125	-.34198607	-.46139010
03.00	.03186423	-.22946885	-.30791584	-.43858636
03.50	.06229355	-.21734688	-.25038359	-.37938424
04.00	.07079605	-.21847600	-.21005520	-.32208345
04.50	.06336756	-.21991289	-.17484680	-.27238080
05.00	.04796772	-.21531795	-.14224227	-.23351322
07.50	.00933781	-.14664596	-.05348317	-.15372942
10.00	-.00461873	-.11215262	-.02621346	-.11512366
15.00	-.00190719	-.06566349	-.01229397	-.08113036
20.00	.00152687	-.05125040	-.00810425	-.05963234

Table 1208.2 **AERODYNAMIC FLUTTER COEFFICIENTS** (Continued), Moment, M = 1.8

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.30195458	-218.01358	-60308.788	-25.478348
00.02	-.30193843	-109.00453	-15076.922	-12.741407
00.03	-.30191153	-72.667168	-6700.6500	-8.4967519
00.04	-.30187387	-54.497734	-3768.9550	-6.3751684
00.06	-.30176628	-36.326793	-1674.8872	-4.2550721
00.08	-.30161571	-27.239816	-941.96353	-3.1965097
00.10	-.30142220	-21.786426	-602.72470	-2.5625594
00.15	-.30075101	-14.511744	-267.67443	-1.7207441
00.20	-.29981321	-10.870680	-150.40745	-1.3035153
00.25	-.29861069	-8.6830953	-96.130274	-1.0560951
00.30	-.29714584	-7.2222842	-66.647091	-.89355142
00.35	-.29542158	-6.1768073	-48.870404	-.77947984
00.40	-.29344133	-5.3909503	-37.333411	-.69567364
00.50	-.28872908	-4.2866886	-23.768017	-.58242698
00.60	-.28304638	-3.5462229	-16.401929	-.51128185
00.70	-.27643792	-3.0139064	-11.963240	-.46397546
00.80	-.26895539	-2.6119499	-9.0852079	-.43134753
00.90	-.26065688	-2.2971644	-7.1148756	-.40828590
01.00	-.25160624	-2.0436572	-5.7083099	-.39170499
01.20	-.23152887	-1.6601312	-3.8835814	-.37072335
01.40	-.20932293	-1.3838626	-2.7925791	-.35898897
01.60	-.18563284	-1.1761500	-2.0931143	-.35173138
01.80	-.16112159	-1.0154670	-1.6214248	-.34630004
02.00	-.13644452	-.88881234	-1.2910051	-.34115355
02.20	-.11222440	-.78778379	-1.0525639	-.33539633
02.40	-.08902894	-.70662371	-.87627629	-.32854132
02.60	-.06735173	-.64117614	-.74319906	-.32037556
02.80	-.04759733	-.58830110	-.64081680	-.31087623
03.00	-.03007128	-.54553304	-.56059430	-.30015312
03.50	.00292844	-.47056664	-.42191814	-.26943348
04.00	.02060134	-.42413480	-.33319465	-.23659960
04.50	.02571929	-.39157492	-.26955511	-.20579851
05.00	.02281766	-.36429955	-.22015258	-.17986018
07.50	.00446072	-.24998029	-.09228055	-.11871352
10.00	-.00216224	-.19006287	-.04992360	-.08942962
15.00	-.00076647	-.12210497	-.02252339	-.06224005
20.00	.00054994	-.09289662	-.01305355	-.04607191

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 1.9

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.25162738	-109.00604	-30154.235	-57.568126
00.02	-.25160962	-54.500753	-7538.3023	-28.786406
00.03	-.25158003	-36.331319	-3350.1665	-19.193540
00.04	-.25153860	-27.245848	-1884.3190	-14.397888
00.06	-.25142026	-18.158869	-837.28519	-9.6037960
00.08	-.25125464	-13.613874	-470.82345	-7.2083087
00.10	-.25104180	-10.885674	-301.20415	-5.7722613
00.15	-.25030366	-7.2445824	-133.67938	-3.8611506
00.20	-.24927253	-5.4203228	-75.046416	-2.9094495
00.25	-.24795070	-4.3228329	-47.908493	-2.3414816
00.30	-.24634107	-3.5887673	-33.167712	-1.9653474
00.35	-.24444719	-3.0624136	-24.280324	-1.6987983
00.40	-.24227320	-2.6659219	-18.512925	-1.5007048
00.50	-.23710459	-2.1068486	-11.732837	-1.2276056
00.60	-.23088040	-1.7299635	-8.0529396	-1.0500250
00.70	-.22365476	-1.4574943	-5.8372523	-.92676783
00.80	-.21549015	-1.2505938	-4.4023759	-.83720269
00.90	-.20645672	-1.0877109	-3.4217986	-.76984108
01.00	-.19663142	-.95593798	-2.7235178	-.71776904
01.20	-.17494224	-.75567915	-1.8222389	-.64329151
01.40	-.15114126	-.61126898	-1.2889787	-.59285689
01.60	-.12599625	-.50347293	-.95227897	-.55594834
01.80	-.10029107	-.42155140	-.72988436	-.52673915
02.00	-.07479286	-.35893668	-.57817248	-.50180780
02.20	-.05022109	-.31127632	-.47214659	-.47909393
02.40	-.02721995	-.27546601	-.39657478	-.45736880
02.60	-.00633535	-.24914136	-.34170836	-.43594141
02.80	.01200245	-.23040069	-.30106337	-.41448115
03.00	.02749000	-.21765136	-.27020263	-.39290219
03.50	.05292637	-.20344770	-.21774664	-.33919298
04.00	.06047671	-.20178248	-.18148559	-.28870954
04.50	.05456167	-.20158682	-.15066304	-.24518478
05.00	.04141908	-.19706339	-.12255091	-.21088746
07.50	.00453909	-.13291205	-.04477997	-.13939047
10.00	-.00481542	-.10003511	-.02258886	-.10521345
15.00	-.00076154	-.05972355	-.01114357	-.07323802
20.00	.00075457	-.04690076	-.00669898	-.05378946

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 1.9

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.24503073	-196.02683	-52273.861	-32.672499
00.02	-.24501771	-98.011576	-13068.251	-16.337985
00.03	-.24499601	-65.339009	-5807.9527	-10.893918
00.04	-.24496565	-49.002113	-3266.8484	-8.1724633
00.06	-.24487889	-32.663994	-1451.7739	-5.4521643
00.08	-.24475747	-24.493711	-816.49791	-4.0931697
00.10	-.24460143	-19.590566	-522.45596	-3.2786958
00.15	-.24406018	-13.050200	-232.04449	-2.1954139
00.20	-.24330391	-9.7769959	-130.40096	-1.6566330
00.25	-.24233409	-7.8106816	-83.355045	-1.3356326
00.30	-.24115262	-6.4978391	-57.799795	-1.1235012
00.35	-.23976178	-5.5584372	-42.391359	-.97355843
00.40	-.23816428	-4.8524645	-32.391281	-.86246089
00.50	-.23436208	-3.8608002	-20.632821	-.71010121
00.60	-.22977540	-3.1961989	-14.247653	-.61191752
00.70	-.22443950	-2.7187031	-10.399788	-.54452309
00.80	-.21839516	-2.3583619	-7.9045818	-.49620228
00.90	-.21168828	-2.0763352	-6.1960757	-.46042850
01.00	-.20436935	-1.8493363	-4.9761637	-.43327160
01.20	-.18811723	-1.5061424	-3.3928959	-.39558935
01.40	-.17011439	-1.2590589	-2.4454258	-.37124156
01.60	-.15087346	-1.0732732	-1.8372070	-.35421924
01.80	-.13092384	-.92942964	-1.4263488	-.34118065
02.00	-.11079133	-.81585174	-1.1379227	-.33015525
02.20	-.09097851	-.72501043	-.92925288	-.31995188
02.40	-.07194701	-.65176483	-.77453130	-.30985878
02.60	-.05410215	-.59242214	-.65737499	-.29947721
02.80	-.03778076	-.54420821	-.56696463	-.28862110
03.00	-.02324263	-.50495753	-.49592241	-.27725143
03.50	.00433598	-.43534288	-.37271307	-.24714456
04.00	.01928314	-.39158055	-.29383352	-.21667610
04.50	.02362763	-.36086091	-.23748526	-.18863244
05.00	.02095245	-.33550089	-.19393858	-.16504543
07.50	.00226753	-.22962132	-.08063001	-.10890601
10.00	-.00224756	-.17331059	-.04399173	-.08253240
15.00	-.00016514	-.11210485	-.02014673	-.05686051
20.00	.00010553	-.08527559	-.01132629	-.04212360

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 2.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.20419112	-98.012801	-26136.808	-59.898672
00.02	-.20417680	-49.004563	-6534.0030	-29.951153
00.03	-.20415293	-32.667667	-2903.8539	-19.969454
00.04	-.20411953	-24.498607	-1633.3017	-14.979211
00.06	-.20402410	-16.328323	-725.76452	-9.9901770
00.08	-.20389055	-12.241959	-408.12658	-7.4968692
00.10	-.20371892	-9.7891650	-261.10569	-6.0018503
00.15	-.20312368	-6.5159384	-115.90025	-4.0112993
00.20	-.20229213	-4.8763107	-65.078879	-3.0190140
00.25	-.20122608	-3.8901520	-41.556436	-2.4260113
00.30	-.19992780	-3.2307591	-28.779437	-2.0326248
00.35	-.19840008	-2.7581224	-21.075957	-1.7532785
00.40	-.19664622	-2.4022417	-16.076764	-1.5451805
00.50	-.19247550	-1.9007679	-10.199548	-1.2571297
00.60	-.18745126	-1.5630574	-7.0093923	-1.0685817
00.70	-.18161618	-1.3191725	-5.0882841	-.93669381
00.80	-.17501960	-1.1341757	-3.8438786	-.84001881
00.90	-.16771691	-.98868217	-2.9931714	-.76662091
01.00	-.15976901	-.87107975	-2.3870822	-.70932245
01.20	-.14220443	-.69251473	-1.6040241	-.62622151
01.40	-.12289604	-.56378995	-1.1397699	-.56904785
01.60	-.10245502	-.46759815	-.84576805	-.52691745
01.80	-.08150788	-.39428774	-.65078630	-.49379204
02.00	-.06067097	-.33797472	-.51707595	-.46610220
02.20	-.04052615	-.29478156	-.42302760	-.44166313
02.40	-.02159885	-.26196492	-.35548865	-.41912710
02.60	-.00433961	-.23745555	-.30605029	-.39768215
02.80	.01089034	-.21960545	-.26912344	-.37687303
03.00	.02382865	-.20704599	-.24088237	-.35648681
03.50	.04535923	-.19150192	-.19262073	-.30730817
04.00	.05206297	-.18775988	-.15960693	-.26216291
04.50	.04726939	-.18623003	-.13215844	-.22345952
05.00	.03595722	-.18163009	-.10747541	-.19278468
07.50	.00125441	-.12152155	-.03839747	-.12785994
10.00	-.00447199	-.09017883	-.02003388	-.09712233
15.00	.00005184	-.05521498	-.01020634	-.06673146
20.00	.00006174	-.04316605	-.00560648	-.04916632

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 2.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.16920207	-163.78963	-41288.664	-39.242215
00.02	-.16919317	-81.893545	-10322.027	-19.622229
00.03	-.16917834	-54.594287	-4587.4648	-13.082732
00.04	-.16915759	-40.944235	-2580.3680	-9.8133570
00.06	-.16909829	-27.293338	-1146.7275	-6.5447290
00.08	-.16901530	-20.467045	-644.95334	-4.9111613
00.10	-.16890865	-16.370595	-412.70365	-3.9316169
00.15	-.16853868	-10.906702	-183.32145	-2.6272918
00.20	-.16802170	-8.1726682	-103.03799	-1.9769775
00.25	-.16735867	-6.5305952	-65.878553	-1.5882551
00.30	-.16655084	-5.4345207	-45.693534	-1.3303151
00.35	-.16559971	-4.6504642	-33.522973	-1.1470940
00.40	-.16450706	-4.0614383	-25.624188	-1.0105578
00.50	-.16190560	-3.2345148	-16.336263	-.82146383
00.60	-.15876580	-2.6808106	-11.292346	-.69759756
00.70	-.15511089	-2.2833749	-8.2524287	-.61089761
00.80	-.15096776	-1.9837511	-6.2808230	-.54731904
00.90	-.14636670	-1.7494783	-4.9305104	-.49904764
01.00	-.14134111	-1.5610916	-3.9660379	-.46138572
01.20	-.13016343	-1.2765991	-2.7134421	-.40689724
01.40	-.11775077	-1.0719788	-1.9628113	-.36967911
01.60	-.10444556	-.91812140	-1.4799811	-.34260781
01.80	-.09060361	-.79885090	-1.1529436	-.32172019
02.00	-.07658102	-.70442481	-.92258033	-.30465686
02.20	-.06272143	-.62858203	-.75524355	-.28995317
02.40	-.04934426	-.56707054	-.63060277	-.27668245
02.60	-.03673438	-.51685909	-.53576423	-.26426105
02.80	-.02513361	-.47569149	-.46221954	-.25233384
03.00	-.01473439	-.44182417	-.40416871	-.24070224
03.50	.00522886	-.38057992	-.30295183	-.21250275
04.00	.01625799	-.34106460	-.23806577	-.18594757
04.50	.01949105	-.31314089	-.19202244	-.16219354
05.00	.01727149	-.29053094	-.15673756	-.14227407
07.50	-.00042348	-.19788733	-.06446539	-.09396320
10.00	-.00185747	-.14762339	-.03582763	-.07183640
15.00	.00049873	-.09698463	-.01666305	-.04856975
20.00	-.00039155	-.07332470	-.00897591	-.03622339

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 2.2

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.14100093	-81.894391	-20644.253	-60.000415
00.02	-.14099115	-40.945926	-5160.9351	-30.001378
00.03	-.14097484	-27.295874	-2293.6540	-20.002219
00.04	-.14095200	-20.470426	-1290.1056	-15.003029
00.06	-.14088678	-13.644132	-573.28536	-10.004618
00.08	-.14079550	-10.230141	-322.39833	-7.5061914
00.10	-.14067819	-8.1810729	-206.27354	-6.0077572
00.15	-.14027131	-5.4470241	-91.582623	-4.0116528
00.20	-.13970286	-4.0779172	-51.441147	-3.0155264
00.25	-.13897402	-3.2548068	-32.861756	-2.4193762
00.30	-.13808629	-2.7047159	-22.769646	-2.0231984
00.35	-.13704150	-2.3106580	-16.684836	-1.7412739
00.40	-.13584180	-2.0141433	-12.735984	-1.5307407
00.50	-.13298790	-1.5967769	-8.0933073	-1.2381148
00.60	-.12954800	-1.3161762	-5.5728998	-1.0452822
00.70	-.12555024	-1.1138935	-4.0547460	-.90934878
00.80	-.12102715	-.96072638	-3.0709876	-.80885092
00.90	-.11601533	-.84046835	-2.3980999	-.73185117
01.00	-.11055504	-.74340854	-1.9183394	-.67117661
01.20	-.09846607	-.59626831	-1.2975391	-.58203070
01.40	-.08513947	-.49027824	-.92831314	-.51980505
01.60	-.07098390	-.41095744	-.69340475	-.47365996
01.80	-.05642111	-.35024372	-.53662891	-.43757454
02.00	-.04186946	-.30324396	-.42824561	-.40796612
02.20	-.02772811	-.26676055	-.35125723	-.38260619
02.40	-.01436246	-.23855948	-.29533777	-.36007516
02.60	-.00209154	-.21698217	-.25389795	-.33946516
02.80	.00882202	-.20072993	-.22256387	-.32020599
03.00	.01817928	-.18874095	-.19834176	-.30195660
03.50	.03407253	-.17184320	-.15660166	-.25979948
04.00	.03938201	-.16536295	-.12845914	-.22247045
04.50	.03609659	-.16186595	-.10585508	-.19079399
05.00	.02753303	-.15696458	-.08604084	-.16549184
07.50	-.00247022	-.10378179	-.02985978	-.11032335
10.00	-.00324324	-.07531876	-.01668830	-.08453943
15.00	.00086297	-.04849869	-.00867195	-.05677331
20.00	-.00065760	-.03705195	-.00422782	-.04229570

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 2.2

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.12260047	-141.23759	-34181.890	-40.947725
00.02	-.12259408	-70.617873	-8545.3765	-20.474636
00.03	-.12258342	-47.077561	-3797.8741	-13.650617
00.04	-.12256849	-35.307098	-2136.2482	-10.238866
00.06	-.12252587	-23.536023	-949.37262	-6.8276299
00.08	-.12246620	-17.649874	-533.96620	-5.1225270
00.10	-.12238953	-14.117695	-341.69241	-4.0998767
00.15	-.12212354	-9.4067042	-151.79252	-2.7375401
00.20	-.12175184	-7.0496958	-85.327761	-2.0576477
00.25	-.12127510	-5.6342926	-54.564306	-1.6507245
00.30	-.12069418	-4.6897048	-37.853536	-1.3802768
00.35	-.12001013	-4.0141679	-27.777722	-1.1878057
00.40	-.11922419	-3.5068014	-21.238390	-1.0440601
00.50	-.11735252	-2.7948273	-13.548853	-.84423798
00.60	-.11509264	-2.3184172	-9.3727649	-.71254269
00.70	-.11246076	-1.9767169	-6.8556807	-.61970455
00.80	-.10947568	-1.7193127	-5.2229702	-.55107902
00.90	-.10615858	-1.5182080	-4.1045612	-.49852237
01.00	-.10253284	-1.3566130	-3.3055318	-.45714204
01.20	-.09445862	-1.1128064	-2.2672788	-.39647230
01.40	-.08547520	-.93759816	-1.6444504	-.35433509
01.60	-.07582421	-.80587130	-1.2432256	-.32333657
01.80	-.06575795	-.70367236	-.97091475	-.29936333
02.00	-.05553042	-.62260625	-.77861364	-.27995797
02.20	-.04538851	-.55728998	-.63850284	-.26358003
02.40	-.03556383	-.50408179	-.53378472	-.24923492
02.60	-.02626530	-.46039979	-.45381407	-.23627242
02.80	-.01767307	-.42433579	-.39157110	-.22426955
03.00	-.00993371	-.39442692	-.34227808	-.21295812
03.50	.00505745	-.33951332	-.25595882	-.18682921
04.00	.01346082	-.30331683	-.20055656	-.16332524
04.50	.01594488	-.27751055	-.16144672	-.14273399
05.00	.01412114	-.25684121	-.13170016	-.12552369
07.50	-.00173108	-.17423752	-.05389756	-.08302178
10.00	-.00128644	-.12893701	-.03046248	-.06381017
15.00	.00067990	-.08581543	-.01418174	-.04254889
20.00	-.00043523	-.06438860	-.00754892	-.03197136

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 2.4

Ω	$\overline{C}_{Mh}$	C^*_{Mh}	$\overline{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.10216649	-70.618486	-17090.891	-57.662911
00.02	-.10215945	-35.308324	-4272.6345	-28.832261
00.03	-.10214773	-23.537861	-1898.8833	-19.222402
00.04	-.10213132	-17.652323	-1068.0704	-14.417741
00.06	-.10208443	-11.766173	-474.63260	-9.6136162
00.08	-.10201880	-8.8224867	-266.92942	-7.2120898
00.10	-.10193447	-7.0557865	-170.79256	-5.7716020
00.15	-.10164194	-4.6987675	-75.842737	-3.8521961
00.20	-.10123323	-3.5187485	-42.610535	-2.8938190
00.25	-.10070915	-2.8095436	-27.229031	-2.3198433
00.30	-.10007076	-2.3357607	-18.873919	-1.9380576
00.35	-.09931932	-1.9965203	-13.836334	-1.6660836
00.40	-.09845634	-1.7413849	-10.567037	-1.4627303
00.50	-.09640286	-1.3825637	-6.7231480	-1.1794977
00.60	-.09392666	-1.1416353	-4.6361647	-.99222938
00.70	-.09104739	-.96819245	-3.3788575	-.85971262
00.80	-.08778777	-.83704681	-2.5639017	-.76132976
00.90	-.08417341	-.73421715	-2.0062510	-.68561746
01.00	-.08023250	-.65132427	-1.6084329	-.62569052
01.20	-.07149526	-.52582930	-1.0930776	-.53710253
01.40	-.06184277	-.43550282	-.78584706	-.47484741
01.60	-.05156364	-.36784265	-.58971303	-.42853960
01.80	-.04095730	-.31589498	-.45820813	-.39240778
02.00	-.03032266	-.27545181	-.36675723	-.36300725
02.20	-.01994722	-.24377912	-.30133160	-.33817878
02.40	-.01009688	-.21898419	-.25342148	-.31652617
02.60	-.00100695	-.19967874	-.21760496	-.29713264
02.80	.00712520	-.18479061	-.19028750	-.27939604
03.00	.01415123	-.17345505	-.16900983	-.26293628
03.50	.02625076	-.15618122	-.13211508	-.22595640
04.00	.03049795	-.14813595	-.10746927	-.19407216
04.50	.02814223	-.14335196	-.08817602	-.16725884
05.00	.02150152	-.13815262	-.07163603	-.14574223
07.50	-.00405807	-.09065714	-.02455477	-.09748092
10.00	-.00202888	-.06481550	-.01455025	-.07506921
15.00	.00101579	-.04337622	-.00743542	-.04962161
20.00	-.00067786	-.03236456	-.00353965	-.03735068

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 2.4

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.09210196	-124.52355	-29228.459	-40.643626
00.02	-.09209719	-62.261082	-7307.0451	-20.322373
00.03	-.09208923	-41.506621	-3247.5241	-13.548872
00.04	-.09207809	-31.129160	-1826.6917	-10.162307
00.06	-.09204626	-20.751239	-811.81151	-6.7761166
00.08	-.09200172	-15.561819	-456.60345	-5.0833941
00.10	-.09194447	-12.447800	-292.19289	-4.0680587
00.15	-.09174587	-8.2947070	-129.81219	-2.7151449
00.20	-.09146833	-6.2170240	-72.979099	-2.0396121
00.25	-.09111233	-4.9695138	-46.673662	-1.6350256
00.30	-.09067850	-4.1370994	-32.384464	-1.3659057
00.35	-.09016762	-3.5418925	-23.768711	-1.1741886
00.40	-.08958057	-3.0949505	-18.176942	-1.0308413
00.50	-.08818228	-2.4679817	-11.601539	-.83118583
00.60	-.08649344	-2.0486763	-8.0303955	-.69918445
00.70	-.08452587	-1.7481111	-5.8778049	-.60579079
00.80	-.08229330	-1.5218344	-4.4813934	-.53647464
00.90	-.07981117	-1.3451590	-3.5247200	-.48315804
01.00	-.07709660	-1.2032789	-2.8411120	-.44098960
01.20	-.07104557	-.98937973	-1.9524937	-.37876131
01.40	-.06430312	-.83577544	-1.4190057	-.33519388
01.60	-.05704692	-.72030976	-1.0749386	-.30296939
01.80	-.04946324	-.63067598	-.84105958	-.27801706
02.00	-.04174044	-.55947499	-.67557624	-.25790099
02.20	-.03406268	-.50196994	-.55472435	-.24108668
02.40	-.02660392	-.45496507	-.46416249	-.22657346
02.60	-.01952252	-.41620402	-.39480754	-.21369538
02.80	-.01295661	-.38402826	-.34067333	-.20200602
03.00	-.00702043	-.35717448	-.29768256	-.19120803
03.50	.00455812	-.30727170	-.22216445	-.16701438
04.00	.01112201	-.27379797	-.17363582	-.14593376
04.50	.01307697	-.24971825	-.13951911	-.12776021
05.00	.01157608	-.23054777	-.11374170	-.11262121
07.50	-.00229737	-.15589626	-.04649770	-.07459467
10.00	-.00078436	-.11476600	-.02663555	-.05749734
15.00	.00063021	-.07706564	-.01231412	-.03800379
20.00	-.00028201	-.05749754	-.00661221	-.02870482

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 2.6

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.07675121	-62.261543	-14614.191	-54.623766
00.02	-.07674596	-31.130081	-3653.4839	-27.312465
00.03	-.07673720	-20.752620	-1623.7234	-18.208956
00.04	-.07672495	-15.563659	-913.30719	-13.657396
00.06	-.07668994	-10.374239	-405.86708	-9.1062234
00.08	-.07664094	-7.7790688	-228.26307	-6.8310243
00.10	-.07657798	-6.2216001	-146.05782	-5.4662141
00.15	-.07635956	-4.1439092	-64.867561	-3.6473666
00.20	-.07605438	-3.1039295	-36.451140	-2.7389009
00.25	-.07566303	-2.4790447	-23.298583	-2.1945809
00.30	-.07518627	-2.0617183	-16.154180	-1.8323260
00.35	-.07462503	-1.7630084	-11.846535	-1.5741003
00.40	-.07398041	-1.5384454	-9.0509155	-1.3808847
00.50	-.07244619	-1.2228291	-5.7638461	-1.1114407
00.60	-.07059551	-1.0111263	-3.9790371	-.93293596
00.70	-.06844270	-.85889030	-2.9036298	-.80633573
00.80	-.06600434	-.74390897	-2.2064308	-.71211449
00.90	-.06329912	-.65385147	-1.7292123	-.63941819
01.00	-.06034767	-.58132650	-1.3886299	-.58172920
01.20	-.05379697	-.47165196	-.94703827	-.49614727
01.40	-.04654788	-.39277177	-.68331280	-.43576975
01.60	-.03881278	-.33365175	-.51451505	-.39077701
01.80	-.03081291	-.28815824	-.40094135	-.35571122
02.00	-.02277026	-.25258696	-.32160740	-.32730931
02.20	-.01489969	-.22454114	-.26454552	-.30351703
02.40	-.00740148	-.20237272	-.22250466	-.28299489
02.60	-.00045472	-.18488414	-.19087077	-.26485046
02.80	.00578826	-.17116080	-.16658835	-.24848363
03.00	.01120618	-.16047362	-.14756809	-.23349193
03.50	.02065543	-.14331415	-.11442843	-.20051150
04.00	.02409166	-.13439067	-.09242993	-.17263753
04.50	.02234181	-.12877905	-.07554637	-.14938179
05.00	.01708841	-.12336089	-.06134945	-.13066937
07.50	-.00458942	-.08058260	-.02100806	-.08757844
10.00	-.00108694	-.05708455	-.01300626	-.06760812
15.00	.00088499	-.03916046	-.00643320	-.04427652
20.00	-.00041776	-.02875961	-.00317421	-.03354327

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 2.6

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.07117353	-111.60166	-25583.549	-39.485203
00.02	-.07116986	-55.800294	-6395.8351	-19.743022
00.03	-.07116374	-37.199603	-2842.5546	-13.162483
00.04	-.07115517	-27.899080	-1598.9065	-9.8723529
00.06	-.07113070	-18.598201	-710.58640	-6.5825036
00.08	-.07109644	-13.947406	-399.67439	-4.9378590
00.10	-.07105242	-11.156646	-255.76656	-3.9512961
00.15	-.07089969	-7.4348070	-113.63545	-2.6365300
00.20	-.07068626	-5.5730091	-63.889676	-1.9798410
00.25	-.07041247	-4.4552343	-40.864613	-1.5863783
00.30	-.07007881	-3.7094783	-28.357302	-1.3245240
00.35	-.06968585	-3.1763120	-20.815925	-1.1378695
00.40	-.06923427	-2.7760220	-15.921420	-.99820963
00.50	-.06815848	-2.2146486	-10.165870	-.80346078
00.60	-.06685884	-1.8393728	-7.0399070	-.67445726
00.70	-.06534426	-1.5704960	-5.1555713	-.58298403
00.80	-.06362509	-1.3681765	-3.9330910	-.51492837
00.90	-.06171300	-1.2102863	-3.0954882	-.46244563
01.00	-.05962092	-1.0835537	-2.4968766	-.42082559
01.20	-.05495388	-.89261059	-1.7185098	-.35917097
01.40	-.04974736	-.75557588	-1.2509220	-.31580218
01.60	-.04413630	-.65258371	-.94908447	-.28362257
01.80	-.03826260	-.57260054	-.74366203	-.25868493
02.00	-.03227029	-.50899598	-.59809058	-.23862513
02.20	-.02630082	-.45753012	-.49158564	-.22194972
02.40	-.02048856	-.41534842	-.41160932	-.20767912
02.60	-.01495668	-.38044174	-.35022467	-.19515468
02.80	-.00981361	-.35133960	-.30220355	-.18392750
03.00	-.00515015	-.32692769	-.26398638	-.17369060
03.50	.00399595	-.28111950	-.19667470	-.15122936
04.00	.00922724	-.24994830	-.15337538	-.13211240
04.50	.01079551	-.22733882	-.12303583	-.11584228
05.00	.00955305	-.20939733	-.10024450	-.10233233
07.50	-.00247246	-.14123341	-.04103736	-.06786320
10.00	-.00040360	-.10364872	-.02374173	-.05237224
15.00	.00049691	-.06997122	-.01086416	-.03444719
20.00	-.00010207	-.05204393	-.00593356	-.02608485

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 2.8

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.05931095	-55.800650	-12791.746	-51.504728
00.02	-.05930691	-27.899791	-3197.8886	-25.752800
00.03	-.05930018	-18.599268	-1421.2484	-17.169018
00.04	-.05929075	-13.948828	-799.42433	-12.877273
00.06	-.05926383	-9.2980332	-355.26429	-8.5858176
00.08	-.05922615	-6.9722807	-199.80830	-6.4403803
00.10	-.05917773	-5.5765457	-127.85441	-5.1533499
00.15	-.05900977	-3.7147417	-56.788918	-3.4379837
00.20	-.05877508	-2.7829631	-31.916125	-2.5810190
00.25	-.05847410	-2.2232025	-20.403713	-2.0674096
00.30	-.05810740	-1.8494593	-14.150204	-1.7254722
00.35	-.05767570	-1.5820205	-10.379688	-1.4816271
00.40	-.05717982	-1.3810311	-7.9326338	-1.2990837
00.50	-.05599939	-1.0986952	-5.0553303	-1.0443168
00.60	-.05457509	-.90947051	-3.4929184	-.87531667
00.70	-.05291773	-.77351906	-2.5514137	-.75528101
00.80	-.05103982	-.67093062	-1.9409257	-.66580256
00.90	-.04895547	-.59065100	-1.5229599	-.59665021
01.00	-.04668027	-.52605326	-1.2245674	-.54168137
01.20	-.04162613	-.42845951	-.83741686	-.45994794
01.40	-.03602564	-.35831604	-.60588331	-.40213956
01.60	-.03004019	-.30572492	-.45739053	-.35900912
01.80	-.02383844	-.26518611	-.35720615	-.32541667
02.00	-.01759031	-.23338267	-.28698266	-.29828605
02.20	-.01146108	-.20817497	-.23626389	-.27567550
02.40	-.00560580	-.18809933	-.19872059	-.25631218
02.60	-.00016423	-.17209988	-.17032954	-.23934041
02.80	.00474348	-.15937757	-.14842909	-.22417653
03.00	.00902014	-.14930170	-.13120036	-.21042045
03.50	.01654560	-.13250737	-.10106697	-.18060997
04.00	.01935740	-.12312403	-.08115296	-.15581376
04.50	.01802001	-.11699600	-.06610589	-.13526931
05.00	.01379317	-.11144488	-.05366398	-.11871301
07.50	-.00460352	-.07261449	-.01849097	-.07965954
10.00	-.00042228	-.05118396	-.01179878	-.06154653
15.00	.00066761	-.03559996	-.00562587	-.04012481
20.00	-.00013376	-.02594736	-.00293451	-.03048169

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 2.8

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.05626881	-101.28530	-22789.203	-37.982311
00.02	-.05626591	-50.642230	-5697.2603	-18.991481
00.03	-.05626110	-33.761018	-2532.0857	-12.661349
00.04	-.05625435	-25.320271	-1424.2746	-9.4963910
00.06	-.05623508	-16.879243	-632.98101	-6.3316500
00.08	-.05620810	-12.658449	-356.02825	-4.7494960
00.10	-.05617344	-10.125748	-227.83871	-3.8003765
00.15	-.05605317	-6.7481607	-101.23181	-2.5353872
00.20	-.05588509	-5.0586726	-56.919483	-1.9034290
00.25	-.05566948	-4.0444293	-36.409302	-1.5246798
00.30	-.05540670	-3.3678141	-25.268070	-1.2725315
00.35	-.05509721	-2.8841350	-18.550363	-1.0927226
00.40	-.05474152	-2.5210472	-14.190420	-.95812194
00.50	-.05389406	-2.0119586	-9.0634259	-.77028047
00.60	-.05287005	-1.6717530	-6.2787842	-.64569436
00.70	-.05167641	-1.4280970	-4.6001348	-.55722470
00.80	-.05032115	-1.2448299	-3.5110324	-.49129803
00.90	-.04881333	-1.1018674	-2.7647528	-.44037029
01.00	-.04716297	-.98716271	-2.2313453	-.39991236
01.20	-.04347903	-.81443176	-1.5375954	-.33982869
01.40	-.03936528	-.69053235	-1.1206330	-.29743508
01.60	-.03492691	-.59742838	-.85128126	-.26591326
01.80	-.03027476	-.52510299	-.66778981	-.24147134
02.00	-.02552170	-.46753878	-.53759999	-.22183695
02.20	-.02077899	-.42089117	-.44220895	-.20557205
02.40	-.01615280	-.38257579	-.37045896	-.19172989
02.60	-.01174099	-.35077818	-.31528967	-.17966977
02.80	-.00763034	-.32417479	-.27205235	-.16895035
03.00	-.00389422	-.30176692	-.23758305	-.15926502
03.50	.00346549	-.25938412	-.17673988	-.13833474
04.00	.00770525	-.23019986	-.13756631	-.12083863
04.50	.00898340	-.20887527	-.11019196	-.10610384
05.00	.00794719	-.19198125	-.08973122	-.09390548
07.50	-.00244600	-.12922633	-.03683936	-.06233746
10.00	-.00013436	-.09468064	-.02145984	-.04811509
15.00	.00035068	-.06409111	-.00971385	-.03157571
20.00	.00003675	-.04762340	-.00539899	-.02392277

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 3.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.04689042	-50.642511	-11394.579	-48.532901
00.02	-.04688723	-25.320834	-2848.6079	-24.266787
00.03	-.04688193	-16.880087	-1266.0206	-16.178232
00.04	-.04687451	-12.659573	-712.11505	-12.134067
00.06	-.04685331	-8.4387780	-316.46825	-8.0901259
00.08	-.04682365	-6.3280998	-177.99188	-6.0683795
00.10	-.04678551	-5.0614688	-113.89712	-4.8555106
00.15	-.04665325	-3.3719759	-50.593725	-3.2388726
00.20	-.04646843	-2.5265363	-28.437633	-2.4311081
00.25	-.04623140	-2.0187242	-18.182635	-1.9468890
00.30	-.04594261	-1.6797323	-12.612131	-1.6244382
00.35	-.04560259	-1.4372161	-9.2534103	-1.3944219
00.40	-.04521199	-1.2550042	-7.0735913	-1.2221726
00.50	-.04428206	-.99915492	-4.5104569	-.98163679
00.60	-.04315976	-.82779600	-3.1185741	-.82193220
00.70	-.04185347	-.70476959	-2.2797596	-.70838232
00.80	-.04037289	-.61200367	-1.7357872	-.62364422
00.90	-.03872897	-.53946378	-1.3632906	-.55807921
01.00	-.03693381	-.48113367	-1.0972900	-.50590104
01.20	-.03294321	-.39307989	-.75198121	-.42819341
01.40	-.02851644	-.32983164	-.54524286	-.37313536
01.60	-.02377931	-.28239916	-.41243938	-.33202131
01.80	-.01886368	-.24578820	-.32264606	-.30001226
02.00	-.01390283	-.21698992	-.25953341	-.27421026
02.20	-.00902691	-.19406789	-.21380082	-.25278279
02.40	-.00435865	-.17570266	-.17982284	-.23452437
02.60	-.00000935	-.16094794	-.15402679	-.21861968
02.80	.00392442	-.14909292	-.13405109	-.20450730
03.00	.00736364	-.13958124	-.11828291	-.19179692
03.50	.01345844	-.12327720	-.09061830	-.16456918
04.00	.01578414	-.11369544	-.07239529	-.14221099
04.50	.01473772	-.10726312	-.05879771	-.12379931
05.00	.01128685	-.10165201	-.04771721	-.10894970
07.50	.00437454	-.06615507	-.01661429	-.07315360
10.00	.00002234	-.04653532	-.01080753	-.05651112
15.00	.00045086	-.03256799	-.00497682	-.03678860
20.00	.00007811	-.02370476	-.00273715	-.02795077

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 3.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.04533094	-92.839128	-20577.338	-36.372300
00.02	-.04532862	-46.419224	-5144.3025	-18.186407
00.03	-.04532475	-30.945772	-2286.3330	-12.124557
00.04	-.04531933	-23.208932	-1286.0436	-9.0937182
00.06	-.04530386	-15.471866	-571.55125	-6.0630504
00.08	-.04528220	-11.603107	-321.47893	-4.5478877
00.10	-.04525436	-9.2816709	-205.73118	-3.6389270
00.15	-.04515779	-6.1858973	-91.412462	-2.4273774
00.20	-.04502282	-4.6374508	-51.400980	-1.8220270
00.25	-.04484967	-3.7079393	-32.881455	-1.4591536
00.30	-.04463864	-3.0878999	-22.821546	-1.2175158
00.35	-.04439008	-2.6447064	-16.755821	-1.0451524
00.40	-.04410441	-2.3120465	-12.819016	-.91608246
00.50	-.04342368	-1.8457051	-8.1895701	-.73585906
00.60	-.04260102	-1.5341549	-5.6751185	-.61621809
00.70	-.04164189	-1.3110926	-4.1593006	-.53117253
00.80	-.04055264	-1.1433717	-3.1757966	-.46772569
00.90	-.03934046	-1.0125813	-2.5018297	-.41865464
01.00	-.03801330	-.90767787	-2.0200626	-.37962350
01.20	-.03504926	-.74977549	-1.3933539	-.32155650
01.40	-.03173680	-.63656319	-1.0165337	-.28049748
01.60	-.02815963	-.55150378	-.77297082	-.24992291
01.80	-.02440618	-.48541299	-.60691662	-.22620519
02.00	-.02056671	-.43277500	-.48898109	-.20716964
02.20	-.01673046	-.39006797	-.40246552	-.19143840
02.40	-.01298289	-.35492738	-.33730298	-.17810204
02.60	-.00940317	-.32569634	-.28712556	-.16654236
02.80	-.00606188	-.30116957	-.24774193	-.15633049
03.00	-.00301917	-.28044075	-.21630041	-.14716525
03.50	.00299616	-.24097571	-.16070116	-.12758542
04.00	.00648175	-.21353086	-.12487566	-.11144912
04.50	.00753757	-.19334757	-.09989694	-.09797800
05.00	.00666654	-.17736910	-.08130819	-.08685662
07.50	-.00232075	-.11920063	-.03350458	-.05770469
10.00	.00004767	-.08727788	-.01960436	-.04451644
15.00	.00022036	-.05913934	-.00878487	-.02919638
20.00	.00012198	-.04396208	-.00495426	-.02210297

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 3.2

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.03777558	-46.419451	-10288.652	-45.783510
00.02	-.03777303	-23.209385	-2572.1337	-22.892021
00.03	-.03776877	-15.472546	-1143.1489	-15.261643
00.04	-.03776281	-11.604013	-643.00426	-11.446543
00.06	-.03774579	-7.7352535	-285.75807	-7.6316193
00.08	-.03772196	-5.8006476	-160.72192	-5.7243348
00.10	-.03769135	-4.6397035	-102.84806	-4.5801054
00.15	-.03758514	-3.0912533	-45.688740	-3.0548776
00.20	-.03743672	-2.3164696	-25.683056	-2.2927018
00.25	-.03724638	-1.8511575	-16.423367	-1.8357437
00.30	-.03701445	-1.5405864	-11.393501	-1.5313910
00.35	-.03674137	-1.3184443	-8.3607424	-1.3142379
00.40	-.03642765	-1.1515760	-6.3924603	-1.1515809
00.50	-.03568066	-.91735319	-4.0780228	-.92434586
00.60	-.03477898	-.76056503	-2.8211422	-.77337205
00.70	-.03372926	-.64806700	-2.0636352	-.66594893
00.80	-.03253917	-.56329241	-1.5723394	-.58571759
00.90	-.03121740	-.49704200	-1.2358630	-.52358680
01.00	-.02977355	-.44379980	-.99553394	-.47409941
01.20	-.02656207	-.36348154	-.68341518	-.40031317
01.40	-.02299639	-.30582069	-.49638099	-.34796577
01.60	-.01917673	-.26257185	-.37607893	-.30885046
01.80	-.01520829	-.22915497	-.29459588	-.27840554
02.00	-.01119774	-.20281282	-.23719743	-.25389793
02.20	-.00724959	-.18177402	-.19549546	-.23359721
02.40	-.00346277	-.16483537	-.16441971	-.21636221
02.60	.00007250	-.15113796	-.14075243	-.20141782
02.80	.00327743	-.14004056	-.12236827	-.18822672
03.00	.00608691	-.13104489	-.10781655	-.17641167
03.50	.01109427	-.11528767	-.08222082	-.15133181
04.00	.01303728	-.10567335	-.06540190	-.13095405
04.50	.01220223	-.09908216	-.05298008	-.11426290
05.00	.00934878	-.09346769	-.04298542	-.10079621
07.50	-.00404314	-.06081009	-.01515688	-.06769622
10.00	.00030733	-.04277200	-.00996963	-.05225588
15.00	.00026660	-.02997552	-.00445325	-.03403103
20.00	.00020425	-.02187262	-.00255404	-.02581871

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 3.2

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.03710281	-85.782981	-18781.280	-34.768315
00.02	-.03710092	-42.891212	-4695.2942	-17.384365
00.03	-.03709776	-28.593832	-2086.7783	-11.589807
00.04	-.03709334	-21.445050	-1173.7977	-8.6925975
00.06	-.03708071	-14.296082	-521.66876	-5.7955259
00.08	-.03706303	-10.721412	-293.42363	-4.3471282
00.10	-.03704030	-8.5764631	-187.77875	-3.4781999
00.15	-.03696148	-5.7161005	-83.438170	-2.3199497
00.20	-.03685130	-4.2854611	-46.919022	-1.7411669
00.25	-.03670996	-3.4267144	-30.015934	-1.3941688
00.30	-.03653768	-2.8539176	-20.834074	-1.1630608
00.35	-.03633476	-2.4445248	-15.297768	-.99817324
00.40	-.03610153	-2.1372632	-11.704561	-.87467099
00.50	-.03554573	-1.7065913	-7.4791385	-.70215063
00.60	-.03487395	-1.4189391	-5.1840964	-.58754699
00.70	-.03409059	-1.2130418	-3.8005135	-.50602006
00.80	-.03320080	-1.0582708	-2.9027727	-.44514734
00.90	-.03221037	-.93761337	-2.2875424	-.39802535
01.00	-.03112572	-.84086465	-1.8477274	-.36051031
01.20	-.02870228	-.69529066	-1.2755006	-.30462626
01.40	-.02599218	-.59095752	-.93132478	-.26504801
01.60	-.02306326	-.51258088	-.70875484	-.23554378
01.80	-.01998730	-.45167231	-.55691430	-.21264857
02.00	-.01683770	-.40313485	-.44898475	-.19428467
02.20	-.01368724	-.36371571	-.36973123	-.17913455
02.40	-.01060583	-.33123315	-.30997136	-.16632703
02.60	-.00765845	-.30416075	-.26389845	-.15526800
02.80	-.00490335	-.28139063	-.22769177	-.14554319
03.00	-.00239046	-.26209211	-.19875252	-.13685946
03.50	.00259222	-.22514832	-.14750040	-.11847395
04.00	.00549340	-.19924274	-.11445322	-.10349471
04.50	.00637580	-.18008423	-.09145472	-.09108149
05.00	.00563790	-.16491954	-.07440456	-.08085935
07.50	-.00215238	-.11069350	-.03078469	-.05375478
10.00	.00016601	-.08104943	-.01806031	-.04143149
15.00	.00011461	-.05491578	-.00802261	-.02718295
20.00	.00016245	-.04087199	-.00457290	-.02054848

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 3.4

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.03091884	-42.891398	-9390.6259	-43.270818
00.02	-.03091676	-21.445421	-2347.6330	-21.635623
00.03	-.03091328	-14.296638	-1043.3750	-14.423987
00.04	-.03090842	-10.722154	-586.88474	-10.818240
00.06	-.03089453	-7.1474845	-260.82026	-7.2126362
00.08	-.03087508	-5.3599647	-146.69771	-5.4099768
00.10	-.03085009	-4.2873051	-93.875278	-4.3284951
00.15	-.03076339	-2.8566626	-41.705019	-2.8868507
00.20	-.03064224	-2.1408841	-23.445491	-2.1663815
00.25	-.03048686	-1.7110553	-14.994005	-1.7343798
00.30	-.03029752	-1.4242056	-10.403146	-1.4466092
00.35	-.03007458	-1.2190626	-7.6350772	-1.2412534
00.40	-.02981845	-1.0649910	-5.8385700	-1.0874040
00.50	-.02920852	-.84879344	-3.7260885	-.87240573
00.60	-.02847219	-.70413748	-2.5788448	-.72948971
00.70	-.02761479	-.60039641	-1.8873765	-.62774183
00.80	-.02664254	-.52226139	-1.4388728	-.55170209
00.90	-.02556245	-.46123115	-1.1316653	-.49277922
01.00	-.02438228	-.41220787	-.91220372	-.44581652
01.20	-.02175604	-.33829723	-.62708433	-.37573262
01.40	-.01883799	-.28526157	-.45610403	-.32596272
01.60	-.01570935	-.24547800	-.34601076	-.28875461
01.80	-.01245556	-.21471260	-.27133526	-.25979933
02.00	-.00916344	-.19041800	-.21863674	-.23651444
02.20	-.00591827	-.17095991	-.18026658	-.21726339
02.40	-.00280107	-.15523097	-.15160392	-.20096495
02.60	.00011396	-.14244376	-.12971812	-.18688238
02.80	.00276166	-.13201338	-.11267465	-.17450248
03.00	.00508777	-.12348810	-.09915381	-.16346232
03.50	.00925309	-.10829590	-.07532061	-.14019909
04.00	.01089141	-.09875484	-.05968940	-.12146318
04.50	.01021378	-.09210477	-.04824243	-.10618894
05.00	.00782769	-.08652892	-.03913357	-.09386468
07.50	-.00368124	-.05631040	-.01398652	-.06304211
10.00	.00048141	-.03965428	-.00924826	-.04860992
15.00	.00012173	-.02774954	-.00402773	-.03169960
20.00	.00026110	-.02034128	-.00237921	-.02399713

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 3.4

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.03078265	-79.789824	-17292.248	-33.223700
00.02	-.03078108	-39.894681	-4323.0408	-16.612020
00.03	-.03077846	-26.596198	-1921.3358	-11.074869
00.04	-.03077480	-19.946879	-1080.7390	-8.3063499
00.06	-.03076435	-13.297406	-480.31279	-5.5379442
00.08	-.03074971	-9.9725166	-270.16361	-4.1538545
00.10	-.03073090	-7.9774600	-172.89457	-3.3234911
00.15	-.03066565	-5.3170277	-76.826412	-2.2166029
00.20	-.03057445	-3.9864314	-43.202602	-1.6634392
00.25	-.03045744	-3.1877724	-27.639631	-1.3317636
00.30	-.03031483	-2.6550850	-19.185724	-1.1108301
00.35	-.03014684	-2.2743845	-14.088339	-.95317589
00.40	-.02995375	-1.9886791	-10.779996	-.83506916
00.50	-.02949357	-1.5882718	-6.8895392	-.67003355
00.60	-.02893730	-1.3208872	-4.7764083	-.56034593
00.70	-.02828856	-1.1295396	-3.5024658	-.48227063
00.80	-.02755155	-.98573963	-2.6758390	-.42393774
00.90	-.02673103	-.87366234	-2.1093173	-.37875117
01.00	-.02583227	-.78381497	-1.7042970	-.34275189
01.20	-.02382344	-.64866777	-1.1772697	-.28907253
01.40	-.02157576	-.55183947	-.86019273	-.25100946
01.60	-.01914503	-.47911038	-.65506451	-.22261082
01.80	-.01659037	-.42258327	-.51504702	-.20056751
02.00	-.01397238	-.37751684	-.41545289	-.18289498
02.20	-.01135122	-.34088651	-.34225979	-.16833398
02.40	-.00878488	-.31066516	-.28701787	-.15605076
02.60	-.00632739	-.28543639	-.24438496	-.14547537
02.80	-.00402739	-.26417406	-.21084694	-.13620887
03.00	-.00192680	-.24611064	-.18401416	-.12796739
03.50	.00224868	-.21137110	-.13643159	-.11064275
04.00	.00468971	-.18683939	-.10573200	-.09666019
04.50	.00543476	-.16860815	-.08440095	-.08514555
05.00	.00480497	-.15417524	-.06863935	-.07568508
07.50	-.00197071	-.10337674	-.02851804	-.05034063
10.00	.00023942	-.07572487	-.01675215	-.03875601
15.00	.00003335	-.05127364	-.00738794	-.02545018
20.00	.00017177	-.03822197	-.00424077	-.01920483

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 3.6

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.02565207	-39.894835	-8646.1124	-40.984769
00.02	-.02565034	-19.947187	-2161.5089	-20.492560
00.03	-.02564747	-13.297868	-960.65635	-13.661901
00.04	-.02564344	-9.9731317	-540.35798	-10.246631
00.06	-.02563194	-6.6482417	-240.14486	-6.8314769
00.08	-.02561584	-4.9856431	-135.07027	-5.1240167
00.10	-.02559515	-3.9879613	-86.435758	-4.0996339
00.15	-.02552339	-2.6573625	-38.401706	-2.7340613
00.20	-.02542310	-1.9916838	-21.589838	-2.0515641
00.25	-.02529447	-1.5919763	-13.808401	-1.6422949
00.30	-.02513773	-1.3252581	-9.5815052	-1.3696374
00.35	-.02495317	-1.1345373	-7.0328812	-1.1750416
00.40	-.02474111	-.99131875	-5.3787884	-1.0292318
00.50	-.02423611	-.79039988	-3.4337476	-.82541833
00.60	-.02362636	-.65601853	-2.3774088	-.68988365
00.70	-.02291626	-.55968664	-1.7407016	-.59334773
00.80	-.02211090	-.48716393	-1.3276879	-.52116816
00.90	-.02121602	-.43054215	-1.0447603	-.46520830
01.00	-.02023800	-.38507876	-.84261466	-.42058459
01.20	-.01806072	-.31656962	-.57991402	-.35394516
01.40	-.01564003	-.26743037	-.42228181	-.30658470
01.60	-.01304273	-.23056732	-.32069338	-.27116365
01.80	-.01033926	-.20204073	-.25170445	-.24360254
02.00	-.00760127	-.17948123	-.20294558	-.22145590
02.20	-.00489936	-.16137042	-.16738017	-.20317295
02.40	-.00230076	-.14668157	-.14075900	-.18772768
02.60	.00013272	-.13468684	-.12038854	-.17441931
02.80	.00234656	-.12484795	-.10449182	-.16275783
03.00	.00429506	-.11675132	-.09185720	-.15239487
03.50	.00779784	-.10212074	-.06954608	-.13068992
04.00	.00919100	-.09272011	-.05493486	-.11333835
04.50	.00863313	-.08608001	-.04431069	-.09925121
05.00	.00661787	-.08057285	-.03593809	-.08788614
07.50	-.00332475	-.05246665	-.01302051	-.05901917
10.00	.00058029	-.03702074	-.00861952	-.04544985
15.00	.00001319	-.02582826	-.00367844	-.02969287
20.00	.00027075	-.01903575	-.00221366	-.02242294

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 3.6

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Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.02584068	-74.629005	-16036.356	-31.761898
00.02	-.02583936	-37.314309	-4009.0714	-15.881090
00.03	-.02583717	-24.875991	-1781.7965	-10.587551
00.04	-.02583410	-18.656767	-1002.2503	-7.9408276
00.06	-.02582534	-12.437414	-445.43154	-5.2941988
00.08	-.02581308	-9.3276087	-250.54499	-3.9709784
00.10	-.02579732	-7.4616225	-160.34037	-3.1771212
00.15	-.02574265	-4.9733414	-71.249405	-2.1188635
00.20	-.02566624	-3.7288817	-40.067606	-1.5899676
00.25	-.02556820	-2.9819529	-25.634929	-1.2728150
00.30	-.02544871	-2.4837921	-17.795000	-1.0615324
00.35	-.02530795	-2.1277871	-13.067815	-.91074543
00.40	-.02514615	-1.8606322	-9.9997361	-.79776650
00.50	-.02476052	-1.4862627	-6.3918040	-.63985678
00.60	-.02429433	-1.2363080	-4.4321086	-.53486303
00.70	-.02375057	-1.0574676	-3.2506472	-.46009448
00.80	-.02313274	-.92309400	-2.4840083	-.40420403
00.90	-.02244480	-.81838529	-1.9585783	-.36088634
01.00	-.02169114	-.73446209	-1.5829149	-.32635706
01.20	-.02000610	-.60826006	-1.0940332	-.27482944
01.40	-.01811982	-.51786651	-.79983755	-.23825721
01.60	-.01607881	-.44997887	-.60944766	-.21095268
01.80	-.01393239	-.39720922	-.47943085	-.18975385
02.00	-.01173121	-.35512250	-.38689648	-.17276419
02.20	-.00952563	-.32089039	-.31884431	-.15877972
02.40	-.00736428	-.29261854	-.26744171	-.14700249
02.60	-.00529264	-.26898469	-.22773777	-.13688597
02.80	-.00335175	-.24903239	-.19647649	-.12804654
03.00	-.00157714	-.23204774	-.17144426	-.12021003
03.50	.00195777	-.19925419	-.12700589	-.10383246
04.00	.00403137	-.17595737	-.09831971	-.09071767
04.50	.00466620	-.15857008	-.07841440	-.07997584
05.00	.00412488	-.14480074	-.06374893	-.07116856
07.50	-.00179137	-.09701114	-.02659528	-.04735581
10.00	.00028183	-.07111172	-.01562782	-.03641268
15.00	-.00002674	-.04810225	-.00685235	-.02393860
20.00	.00016194	-.03591861	-.00394918	-.01803175

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 3.8

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.02153378	-37.314438	-8018.1684	-38.906456
00.02	-.02153233	-18.657025	-2004.5261	-19.453374
00.03	-.02152992	-12.437801	-890.88867	-12.969078
00.04	-.02152655	-9.3281251	-501.11556	-9.7269782
00.06	-.02151691	-6.2183196	-222.70620	-6.4849757
00.08	-.02150343	-4.6632879	-125.26293	-4.8640713
00.10	-.02148609	-3.7301660	-80.160626	-3.8916061
00.15	-.02142597	-2.4857042	-35.615167	-2.5952111
00.20	-.02134194	-1.8631548	-20.024299	-1.9472535
00.25	-.02123417	-1.4893731	-12.808000	-1.5586691
00.30	-.02110283	-1.2399783	-8.8880832	-1.2997696
00.35	-.02094818	-1.0616647	-6.5245475	-1.1149738
00.40	-.02077049	-.92777999	-4.9905734	-.97649075
00.50	-.02034729	-.73999460	-3.1867628	-.78288043
00.60	-.01983626	-.61443847	-2.2071029	-.65409013
00.70	-.01924105	-.52446533	-1.6165910	-.56232521
00.80	-.01856588	-.45675516	-1.2335200	-.49368636
00.90	-.01781555	-.40391050	-.97108123	-.44045014
01.00	-.01699534	-.36149490	-.78355185	-.39798115
01.20	-.01516875	-.29760621	-.53978524	-.33452437
01.40	-.01313689	-.25179784	-.39343941	-.28939782
01.60	-.01095545	-.21743226	-.29905443	-.25563647
01.80	-.00868319	-.19082311	-.23489311	-.22936918
02.00	-.00638004	-.16975425	-.18948884	-.20827494
02.20	-.00410511	-.15280669	-.15632041	-.19088114
02.40	-.00191487	-.13902253	-.13145133	-.17621243
02.60	.00013865	-.12772453	-.11238748	-.16360140
02.80	.00200933	-.11841361	-.09748422	-.15257998
03.00	.00365833	-.11070805	-.08562063	-.14281399
03.50	.00663243	-.09662369	-.06463901	-.12246174
04.00	.00782636	-.08740536	-.05091477	-.10629406
04.50	.00736129	-.08082242	-.04099545	-.09321604
05.00	.00564397	-.07540489	-.03324452	-.08266754
07.50	-.00299055	-.04914209	-.01220509	-.05550253
10.00	.00062910	-.03475959	-.00806658	-.04268390
15.00	-.00006521	-.02415981	-.00338847	-.02794100
20.00	.00025200	-.01790424	-.00205953	-.02104918

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 3.8

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.02191623	-70.133018	-14961.714	-30.391101
00.02	-.02191512	-35.066345	-3740.4138	-15.195669
00.03	-.02191326	-23.377381	-1662.3952	-10.130578
00.04	-.02191067	-17.532844	-935.08865	-7.5980721
00.06	-.02190325	-11.688197	-415.58400	-5.0656451
00.08	-.02189287	-8.7657648	-233.75738	-3.7995106
00.10	-.02187952	-7.0122179	-149.59764	-3.0398931
00.15	-.02183323	-4.6739013	-66.476925	-2.0272533
00.20	-.02176853	-3.5044724	-37.384706	-1.5211293
00.25	-.02168552	-2.8026004	-23.919200	-1.2176103
00.30	-.02158433	-2.3345092	-16.604640	-1.0153926
00.35	-.02146514	-2.0000091	-12.194229	-.87105993
00.40	-.02132812	-1.7490057	-9.3317414	-.76290401
00.50	-.02100155	-1.3973018	-5.9655639	-.61170503
00.60	-.02060671	-1.1625143	-4.1371649	-.51114070
00.70	-.02014613	-.99455306	-3.0348433	-.43949998
00.80	-.01962276	-.86837552	-2.3195411	-.38592595
00.90	-.01903992	-.77007095	-1.8292793	-.34438577
01.00	-.01840130	-.69129443	-1.4787438	-.31125880
01.20	-.01697309	-.57285954	-1.0225195	-.26179282
01.40	-.01537368	-.48805037	-.74792206	-.22665686
01.60	-.01364227	-.42436367	-.57016404	-.20041050
01.80	-.01182046	-.37485535	-.44872622	-.18002939
02.00	-.00995103	-.33535713	-.36225487	-.16369941
02.20	-.00807662	-.30321153	-.29862384	-.15026849
02.40	-.00623842	-.27663954	-.25052819	-.13897245
02.60	-.00447509	-.25440054	-.21335137	-.12928715
02.80	-.00282158	-.23559829	-.18405791	-.12084382
03.00	-.00130829	-.21956498	-.16058453	-.11337801
03.50	.00171149	-.18850374	-.11887418	-.09785025
04.00	.00348806	-.16632350	-.09193645	-.08549807
04.50	.00403338	-.14970795	-.07326592	-.07542809
05.00	.00356504	-.13654416	-.05954524	-.06718710
07.50	-.00162210	-.09141815	-.02493997	-.04472110
10.00	.00030318	-.06706939	-.01465006	-.03434270
15.00	-.00006972	-.04531652	-.00639476	-.02260534
20.00	.00014182	-.03389388	-.00369196	-.01699867

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 4.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.01826343	-35.066454	-7480.8491	-37.014788
00.02	-.01826220	-17.533063	-1870.1988	-18.507516
00.03	-.01826016	-11.688526	-831.18955	-12.338480
00.04	-.01825731	-8.7662027	-467.53629	-9.2540029
00.06	-.01824915	-5.8437701	-207.78397	-6.1696071
00.08	-.01823773	-4.3824444	-116.87067	-4.6274906
00.10	-.01822305	-3.5055617	-74.790798	-3.7022857
00.15	-.01817214	-2.3361309	-33.230460	-2.4688685
00.20	-.01810099	-1.7511454	-18.684376	-1.8523614
00.25	-.01800973	-1.3999404	-11.951656	-1.4826170
00.30	-.01789852	-1.1656280	-8.2944167	-1.2362524
00.35	-.01776756	-.99811401	-6.0892588	-1.0603889
00.40	-.01761709	-.87235171	-4.6580698	-.92858700
00.50	-.01725869	-.69599017	-2.9751114	-.74428779
00.60	-.01682587	-.57810526	-2.0610694	-.62165975
00.70	-.01632169	-.49365533	-1.5100922	-.53426013
00.80	-.01574972	-.43012221	-1.1526496	-.46886588
00.90	-.01511397	-.38055351	-.90775054	-.41812952
01.00	-.01441890	-.34077952	-.73273650	-.37764146
01.20	-.01287055	-.28089233	-.50519036	-.31711728
01.40	-.01114742	-.23796694	-.36852315	-.27405438
01.60	-.00929645	-.20576348	-.28032463	-.24182823
01.80	-.00736725	-.18081653	-.22031774	-.21675706
02.00	-.00541044	-.16104329	-.17780779	-.19663311
02.20	-.00347608	-.14511117	-.14671403	-.18005506
02.40	-.00161205	-.13212182	-.12336702	-.16609395
02.60	.00013738	-.12144152	-.10544278	-.15411318
02.80	.00173288	-.11260469	-.09140951	-.14366526
03.00	.00314115	-.10525664	-.08022360	-.13442959
03.50	.00568815	-.09169668	-.06041457	-.11526364
04.00	.00671865	-.08268573	-.04746982	-.10012073
04.50	.00632664	-.07619198	-.03816185	-.08791128
05.00	.00485144	-.07087814	-.03094291	-.07806626
07.50	-.00268551	-.04623565	-.01150406	-.05239908
10.00	.00064510	-.03279137	-.00757682	-.04024223
15.00	-.00011997	-.02270125	-.00314489	-.02639424
20.00	.00021843	-.01691053	-.00191824	-.01983997

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 4.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.01507498	-61.054616	-12845.259	-27.355727
00.02	-.01507422	-30.527195	-3211.3048	-13.677944
00.03	-.01507294	-20.351338	-1427.2392	-9.1187184
00.04	-.01507116	-15.263371	-802.81620	-6.8391324
00.06	-.01506608	-10.175330	-356.79979	-4.5595999
00.08	-.01505896	-7.6312338	-200.69405	-3.4198871
00.10	-.01504981	-6.1047160	-128.43940	-2.7361021
00.15	-.01501807	-4.0691843	-57.076792	-1.8245130
00.20	-.01497371	-3.0512323	-32.099901	-1.3688508
00.25	-.01491679	-2.4403134	-20.539192	-1.0955587
00.30	-.01484740	-2.0329126	-14.259325	-.91345063
00.35	-.01476567	-1.7418094	-10.472789	-.78344689
00.40	-.01467170	-1.5233937	-8.0152076	-.68600740
00.50	-.01444772	-1.2174057	-5.1251646	-.54974051
00.60	-.01417688	-1.0131945	-3.5553604	-.45905497
00.70	-.01386088	-.86715306	-2.6089160	-.39440889
00.80	-.01350172	-.75747945	-1.9947363	-.34603038
00.90	-.01310164	-.67206279	-1.5737560	-.30848979
01.00	-.01266314	-.60363761	-1.2727298	-.27852870
01.20	-.01168200	-.50081263	-.88086983	-.23373967
01.40	-.01058239	-.42721791	-.64492294	-.20188174
01.60	-.00939094	-.37196511	-.49209994	-.17806081
01.80	-.00813598	-.32900678	-.38761812	-.15955656
02.00	-.00684671	-.29471340	-.31314924	-.14473703
02.20	-.00555230	-.26677206	-.25828730	-.13256520
02.40	-.00428108	-.24363596	-.21676533	-.12235225
02.60	-.00305969	-.22422819	-.18462416	-.11362452
02.80	-.00191241	-.20777273	-.15926159	-.10604743
03.00	-.00086046	-.19369330	-.13890959	-.09937959
03.50	.00124597	-.16623698	-.10267866	-.08563563
04.00	.00249220	-.14643183	-.07925763	-.07484027
04.50	.00287673	-.13148491	-.06306103	-.06612076
05.00	.00254209	-.11962894	-.05121955	-.05901288
07.50	-.00125972	-.07999632	-.02164512	-.03930240
10.00	.00030512	-.05883120	-.01268198	-.03008766
15.00	-.00012588	-.03963788	-.00549760	-.01986208
20.00	.00007985	-.02974759	-.00316922	-.01488468

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 4.5

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.01256241	-30.527270	-6422.6243	-32.972232
00.02	-.01256158	-15.263522	-1605.6470	-16.486198
00.03	-.01256018	-10.175556	-713.61418	-10.990891
00.04	-.01255822	-7.6315350	-401.40269	-8.2432645
00.06	-.01255262	-5.0874389	-178.39448	-5.4956932
00.08	-.01254479	-3.8153156	-100.34162	-4.1219626
00.10	-.01253473	-3.0519816	-64.214292	-3.2977682
00.15	-.01249982	-2.0340283	-28.533002	-2.1989700
00.20	-.01245104	-1.5248658	-16.044574	-1.6497071
00.25	-.01238846	-1.2192213	-10.264241	-1.3202573
00.30	-.01231221	-1.0153374	-7.1243353	-1.1007130
00.35	-.01222240	-.86960414	-5.2310993	-.94397087
00.40	-.01211921	-.76021693	-4.0023455	-.82647893
00.50	-.01187339	-.60687219	-2.5574118	-.66214123
00.60	-.01157648	-.50442841	-1.7726157	-.55274375
00.70	-.01123054	-.43108438	-1.2995172	-.47473246
00.80	-.01083798	-.37594131	-.99256779	-.41632924
00.90	-.01040153	-.33294580	-.78223386	-.37098976
01.00	-.00992420	-.29846697	-.63189175	-.33478670
01.20	-.00886029	-.24659153	-.43634349	-.28062338
01.40	-.00767524	-.20943314	-.31879621	-.24205034
01.60	-.00640096	-.18155583	-.24284433	-.21316964
01.80	-.00507124	-.15994063	-.19108480	-.19070352
02.00	-.00372066	-.14277399	-.15434154	-.17268609
02.20	-.00238350	-.12889710	-.12739964	-.15786863
02.40	-.00109272	-.11753082	-.10711417	-.14542213
02.60	.00012108	-.10812779	-.09149488	-.13477694
02.80	.00123053	-.10028833	-.07923108	-.12553097
03.00	.00221227	-.09371027	-.06943052	-.11739446
03.50	.00399739	-.08135032	-.05203024	-.10064494
04.00	.00473049	-.07290239	-.04067935	-.08755118
04.50	.00446430	-.06670911	-.03259859	-.07706358
05.00	.00342427	-.06168572	-.02642590	-.06861415
07.50	-.00205512	-.04034055	-.01010374	-.04601976
10.00	.00060963	-.02880774	-.00656912	-.03522856
15.00	-.00018786	-.01975813	-.00268004	-.02320561
20.00	.00011978	-.01487130	-.00162218	-.01736766

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 4.5

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.01082894	-54.145557	-11280.326	-24.816776
00.02	-.01082839	-27.072697	-2820.0744	-12.408445
00.03	-.01082748	-18.048375	-1253.3612	-8.2723601
00.04	-.01082621	-13.536186	-705.01151	-6.2043365
00.06	-.01082256	-9.0239438	-313.33319	-4.1363509
00.08	-.01081746	-6.7677685	-176.24578	-3.1023960
00.10	-.01081090	-5.4140201	-112.79389	-2.4820533
00.15	-.01078816	-3.6088968	-50.125376	-1.6550180
00.20	-.01075636	-2.7062014	-28.191410	-1.2415943
00.25	-.01071556	-2.1644781	-18.039133	-.99361465
00.30	-.01066583	-1.8032418	-12.524334	-.82835648
00.35	-.01060725	-1.5451422	-9.1991019	-.71036705
00.40	-.01053990	-1.3515040	-7.0409170	-.62191993
00.50	-.01037934	-1.0802625	-4.5029430	-.49819932
00.60	-.01018516	-.89927722	-3.1243582	-.41583187
00.70	-.00995858	-.76987519	-2.2931846	-.35708985
00.80	-.00970101	-.67272109	-1.7537911	-.31310870
00.90	-.00941404	-.59707398	-1.3840551	-.27896311
01.00	-.00909946	-.53649006	-1.1196550	-.25169744
01.20	-.00839530	-.44547899	-.77542786	-.21090765
01.40	-.00760569	-.38036355	-.56810558	-.18186791
01.60	-.00674956	-.33148525	-.43376960	-.16014014
01.80	-.00584713	-.29347947	-.34187767	-.14325771
02.00	-.00491925	-.26312682	-.27633746	-.12974075
02.20	-.00398680	-.23837637	-.22801371	-.11864854
02.40	-.00307010	-.21785743	-.19140583	-.10935568
02.60	-.00218834	-.20061681	-.16303970	-.10143143
02.80	-.00135907	-.18596883	-.14063261	-.09457074
03.00	-.00059770	-.17340556	-.12263410	-.08855272
03.50	.00093064	-.14878937	-.09054990	-.07622424
04.00	.00183850	-.13090287	-.06979484	-.06662692
04.50	.00211969	-.11732988	-.05546511	-.05892767
05.00	.00187279	-.10655140	-.04502876	-.05267059
07.50	-.00098283	-.07119586	-.01917120	-.03509041
10.00	.00027558	-.05248354	-.01119212	-.02678891
15.00	-.00014029	-.03527689	-.00483852	-.01772601
20.00	.00002784	-.02653507	-.00277524	-.01325419

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 5.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00902407	-27.072751	-5640.1593	-29.704923
00.02	-.00902347	-13.536295	-1410.0334	-14.852520
00.03	-.00902246	-9.0241061	-626.67674	-9.9017452
00.04	-.00902106	-6.7679849	-352.50192	-7.4263772
00.06	-.00901705	-4.5118095	-156.66276	-4.9510483
00.08	-.00901144	-3.3836678	-88.119058	-3.7134229
00.10	-.00900423	-2.7067396	-56.393118	-2.9708787
00.15	-.00897921	-1.8040434	-25.058868	-1.9809105
00.20	-.00894425	-1.3525617	-14.091898	-1.4860230
00.25	-.00889940	-1.0815670	-9.0157753	-1.1891670
00.30	-.00884474	-.90081707	-6.2583949	-.99132608
00.35	-.00878037	-.77163677	-4.5958016	-.85006446
00.40	-.00870640	-.67468881	-3.5167352	-.74416412
00.50	-.00853018	-.53881596	-2.2478103	-.59601079
00.60	-.00831731	-.44808021	-1.5585930	-.49735615
00.70	-.00806925	-.38314671	-1.1430937	-.42698067
00.80	-.00778771	-.33434934	-.87349633	-.37427381
00.90	-.00747463	-.29631909	-.68873892	-.33334017
01.00	-.00713214	-.26583542	-.55665992	-.30064199
01.20	-.00636846	-.21999616	-.38481674	-.25169534
01.40	-.00551730	-.18717766	-.28145761	-.21681562
01.60	-.00460137	-.16255661	-.21461554	-.19069120
01.80	-.00364478	-.14345425	-.16901117	-.17037031
02.00	-.00267223	-.12826186	-.13658988	-.15408239
02.20	-.00170829	-.11595245	-.11277562	-.14070230
02.40	-.00077662	-.10583674	-.09481000	-.12948230
02.60	.00010071	-.09743190	-.08094835	-.11990775
02.80	.00090388	-.09038687	-.07004247	-.11161440
03.00	.00161588	-.08443776	-.06131123	-.10433873
03.50	.00291545	-.07311908	-.04578073	-.08944571
04.00	.00345475	-.06523351	-.03566117	-.07789241
04.50	.00326542	-.05938356	-.02850829	-.06868493
05.00	.00250513	-.05466115	-.02310637	-.06127311
07.50	-.00158825	-.03583244	-.00904016	-.04106554
10.00	.00053362	-.02575205	-.00579115	-.03134721
15.00	-.00020134	-.01753139	-.00234973	-.02071658
20.00	.00003902	-.01328377	-.00139794	-.01546276

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 5.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.00614895	-44.273132	-9107.6168	-20.871655
00.02	-.00614864	-22.136520	-2276.9002	-10.435859
00.03	-.00614812	-14.757629	-1011.9527	-6.9572750
00.04	-.00614740	-11.068168	-569.22108	-5.2179934
00.06	-.00614534	-7.3786761	-252.98420	-3.4787330
00.08	-.00614245	-5.5338995	-142.30130	-2.6091240
00.10	-.00613874	-4.4270091	-91.070927	-2.0873755
00.15	-.00612586	-2.9510839	-40.473035	-1.3917602
00.20	-.00610786	-2.2130453	-22.763781	-1.0440051
00.25	-.00608476	-1.7701620	-14.566935	-.83539369
00.30	-.00605661	-1.4748568	-10.114338	-.69635387
00.35	-.00602343	-1.2638826	-7.4295717	-.59706886
00.40	-.00598530	-1.1056159	-5.6870657	-.52263024
00.50	-.00589438	-.88395840	-3.6379074	-.41847510
00.60	-.00578440	-.73609712	-2.5248221	-.34910155
00.70	-.00565605	-.63040978	-1.8537055	-.29960044
00.80	-.00551011	-.55108587	-1.4181643	-.26251683
00.90	-.00534748	-.48934232	-1.1195978	-.23370875
01.00	-.00516915	-.43990969	-.90607404	-.21069079
01.20	-.00476978	-.36568343	-.62803669	-.17622492
01.40	-.00432162	-.31260289	-.46052075	-.15166043
01.60	-.00383530	-.27276808	-.35192188	-.13326657
01.80	-.00332218	-.24179088	-.27758360	-.11897009
02.00	-.00279401	-.21703812	-.22451621	-.10752706
02.20	-.00226258	-.19683298	-.18534707	-.09814644
02.40	-.00173944	-.18005570	-.15563810	-.09030177
02.60	-.00123549	-.16592873	-.13258716	-.08362983
02.80	-.00076079	-.15389396	-.11435382	-.07787260
03.00	-.00032420	-.14353925	-.09968854	-.07284240
03.50	.00055500	-.12312389	-.07349995	-.06261652
04.00	.00107999	-.10814692	-.05654246	-.05474714
04.50	.00124342	-.09669834	-.04485953	-.04849131
05.00	.00109834	-.08759016	-.03639515	-.04342917
07.50	-.00061862	-.05847427	-.01566881	-.02894370
10.00	.00020340	-.04327757	-.00908121	-.02200052
15.00	-.00012452	-.02899509	-.00392772	-.01460264
20.00	-.00002777	-.02185553	-.00223002	-.01089695

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 6.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00512410	-22.136551	-4553.8062	-24.771911
00.02	-.00512376	-11.068229	-1138.4480	-12.385988
00.03	-.00512319	-7.3787682	-505.97422	-8.2573617
00.04	-.00512239	-5.5340224	-284.60840	-6.1930594
00.06	-.00512012	-3.6892458	-126.48997	-4.1287790
00.08	-.00511695	-2.7668269	-71.148514	-3.0966605
00.10	-.00511286	-2.2133510	-45.533330	-2.4774068
00.15	-.00509870	-1.4753119	-20.234389	-1.6517859
00.20	-.00507891	-1.1062166	-11.379769	-1.2390293
00.25	-.00505351	-.88469938	-7.2813546	-.99141810
00.30	-.00502257	-.73697190	-5.0550665	-.82637921
00.35	-.00498612	-.63141069	-3.7126962	-.70852407
00.40	-.00494424	-.55220414	-2.8414577	-.62015834
00.50	-.00484445	-.44123215	-1.8169131	-.49650619
00.60	-.00472387	-.36716334	-1.2604122	-.41413528
00.70	-.00458335	-.31418747	-.92490270	-.35535044
00.80	-.00442381	-.27440018	-.70718743	-.31130363
00.90	-.00424636	-.24341075	-.55796585	-.27707894
01.00	-.00405218	-.21858523	-.45127143	-.24972650
01.20	-.00361897	-.18128174	-.31240350	-.20875435
01.40	-.00313573	-.15459232	-.22881404	-.17953485
01.60	-.00261523	-.13457040	-.17469661	-.15764039
01.80	-.00207101	-.11902401	-.13771839	-.14061068
02.00	-.00151701	-.10663722	-.11137986	-.12696975
02.20	-.00096713	-.09657088	-.09199002	-.11577921
02.40	-.00043480	-.08826299	-.07732528	-.10641474
02.60	.00006740	-.08132136	-.06598033	-.09844574
02.80	.00052808	-.07546242	-.05703109	-.09156650
03.00	.00093743	-.07047455	-.04984943	-.08555482
03.50	.00168826	-.06083357	-.03704414	-.07333786
04.00	.00200404	-.05395520	-.02871166	-.06395607
04.50	.00189799	-.04877545	-.02287657	-.05653064
05.00	.00145639	-.04461288	-.01853799	-.05056185
07.50	-.00098846	-.02936089	-.00750235	-.03384488
10.00	.00038180	-.02131889	-.00467674	-.02572239
15.00	-.00017325	-.01437536	-.00190683	-.01706858
20.00	-.00004574	-.01095572	-.00109771	-.01271124

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 6.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.00382861	-37.520975	-7660.5331	-17.978823
00.02	-.00382842	-18.760459	-1915.1308	-8.9894311
00.03	-.00382810	-12.506941	-851.16743	-5.9929759
00.04	-.00382765	-9.3801720	-478.78025	-4.4947548
00.06	-.00382636	-6.2533842	-212.78941	-2.9965468
00.08	-.00382457	-4.6899712	-119.69261	-2.2474559
00.10	-.00382226	-3.7519082	-76.602097	-1.7980118
00.15	-.00381426	-2.5011130	-34.043567	-1.1987834
00.20	-.00380307	-1.8756681	-19.148086	-.89920163
00.25	-.00378872	-1.5003637	-12.253612	-.71947829
00.30	-.00377122	-1.2501299	-8.5084721	-.59968396
00.35	-.00375060	-1.0713653	-6.2502768	-.51413457
00.40	-.00372689	-.93726943	-4.7846276	-.44998803
00.50	-.00367037	-.74948279	-3.0610418	-.36021925
00.60	-.00360200	-.62423586	-2.1247962	-.30041241
00.70	-.00352220	-.53472879	-1.5602935	-.25772498
00.80	-.00343145	-.46756208	-1.1939337	-.22573549
00.90	-.00333031	-.41529186	-.94278283	-.20087623
01.00	-.00321938	-.37345209	-.76316011	-.18100644
01.20	-.00297090	-.31064409	-.52924293	-.15123954
01.40	-.00269193	-.26574250	-.38827954	-.13001093
01.60	-.00238906	-.23205083	-.29686630	-.11410784
01.80	-.00206930	-.20584934	-.23426579	-.10174498
02.00	-.00173995	-.18490602	-.18955375	-.09185122
02.20	-.00140832	-.16779980	-.15653053	-.08374521
02.40	-.00108160	-.15358214	-.13146468	-.07697329
02.60	-.00076659	-.14159495	-.11200075	-.07122214
02.80	-.00046957	-.13136648	-.09659204	-.06626882
03.00	-.00019612	-.12254904	-.08418875	-.06195079
03.50	.00035561	-.10509885	-.06201563	-.05321191
04.00	.00068610	-.09222243	-.04764961	-.04653295
04.50	.00078930	-.08233508	-.03776482	-.04125328
05.00	.00069712	-.07445880	-.03062657	-.03699298
07.50	-.00040893	-.04968508	-.01328501	-.02465803
10.00	.00014615	-.03688026	-.00765377	-.01868576
15.00	-.00009738	-.02466393	-.00332072	-.01242356
20.00	-.00004368	-.01859777	-.00187305	-.00926790

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 7.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00319049	-18.760478	-3830.2652	-21.235854
00.02	-.00319028	-9.3802103	-957.56409	-10.617947
00.03	-.00318993	-6.2534416	-425.58240	-7.0786538
00.04	-.00318943	-4.6900477	-239.38881	-5.3090139
00.06	-.00318802	-3.1266347	-106.39339	-3.5393874
00.08	-.00318605	-2.3449091	-59.844992	-2.6545876
00.10	-.00318351	-1.8758585	-38.299735	-2.1237184
00.15	-.00317471	-1.2504133	-17.020473	-1.4159240
00.20	-.00316240	-.93764350	-9.5727367	-1.0620601
00.25	-.00314662	-.74994425	-6.1255052	-.84976807
00.30	-.00312739	-.62478069	-4.2529416	-.70826178
00.35	-.00310473	-.53535225	-3.1238517	-.60720423
00.40	-.00307870	-.46825872	-2.3910360	-.53142686
00.50	-.00301666	-.37427618	-1.5292644	-.42537547
00.60	-.00294171	-.31156663	-1.0611674	-.35471393
00.70	-.00285433	-.26673072	-.77894601	-.30427319
00.80	-.00275512	-.23306923	-.59580019	-.26646845
00.90	-.00264475	-.20686076	-.47026268	-.23708572
01.00	-.00252396	-.18587275	-.38049287	-.21359642
01.20	-.00225438	-.15434990	-.26362712	-.17839741
01.40	-.00195353	-.13180583	-.19324926	-.15328398
01.60	-.00162928	-.11489446	-.14765483	-.13446150
01.80	-.00129004	-.10175724	-.11647233	-.11982150
02.00	-.00094443	-.09127861	-.09423677	-.10809904
02.20	-.00060109	-.08274762	-.07784542	-.09848963
02.40	-.00026839	-.07568873	-.06542978	-.09045773
02.60	.00004582	-.06977083	-.05580948	-.08363359
02.80	.00033441	-.06475526	-.04820880	-.07775421
03.00	.00059120	-.06046477	-.04210072	-.07262795
03.50	.00106359	-.05209438	-.03119359	-.06225501
04.00	.00126385	-.04603968	-.02410158	-.05433839
04.50	.00119840	-.04143991	-.01916300	-.04810001
05.00	.00091967	-.03775048	-.01552685	-.04309066
07.50	-.00064930	-.02491574	-.00642708	-.02881786
10.00	.00027020	-.01822434	-.00392199	-.02183512
15.00	-.00013369	-.01222710	-.00161728	-.01451948
20.00	-.00006915	-.00932540	-.00091214	-.01081079

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 7.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.00254620	-32.591856	-6621.8379	-15.778612
00.02	-.00254607	-16.295909	-1655.4578	-7.8893189
00.03	-.00254586	-10.863918	-735.75784	-5.2595604
00.04	-.00254556	-8.1479163	-413.86284	-3.9446854
00.06	-.00254471	-5.4319018	-183.93784	-2.6298191
00.08	-.00254351	-4.0738818	-103.46409	-1.9723946
00.10	-.00254198	-3.2590597	-66.216241	-1.5779468
00.15	-.00253667	-2.1726007	-29.428244	-1.0520365
00.20	-.00252923	-1.6293397	-16.552448	-.78910278
00.25	-.00251970	-1.3033581	-10.592798	-.63135956
00.30	-.00250807	-1.0860166	-7.3554611	-.52621145
00.35	-.00249438	-.93075524	-5.4034532	-.45111754
00.40	-.00247863	-.81429431	-4.1365291	-.39480737
00.50	-.00244108	-.65121412	-2.6466381	-.31599717
00.60	-.00239566	-.54245684	-1.8373300	-.26348283
00.70	-.00234264	-.46474315	-1.3493585	-.22599359
00.80	-.00228234	-.40643363	-1.0326622	-.19789391
00.90	-.00221512	-.36106218	-.81555218	-.17605280
01.00	-.00214140	-.32474930	-.66027057	-.15859158
01.20	-.00197622	-.27024774	-.45803881	-.13242477
01.40	-.00179073	-.23129217	-.33615318	-.11375638
01.60	-.00158927	-.20206509	-.25709591	-.09976729
01.80	-.00137651	-.17933490	-.20294222	-.08889107
02.00	-.00115726	-.16116255	-.16424992	-.08018783
02.20	-.00093640	-.14631364	-.13566082	-.07305970
02.40	-.00071868	-.13396450	-.11395030	-.06710843
02.60	-.00050866	-.12354393	-.09708306	-.06205882
02.80	-.00031050	-.11464286	-.08372288	-.05771484
03.00	-.00012795	-.10696011	-.07296297	-.05393338
03.50	.00024086	-.09171815	-.05371414	-.04630217
04.00	.00046221	-.08042842	-.04123780	-.04049565
04.50	.00053148	-.07173372	-.03266044	-.03592266
05.00	.00046936	-.06480121	-.02647977	-.03223960
07.50	-.00028249	-.04322931	-.01154649	-.02149121
10.00	.00010615	-.03215638	-.00662174	-.01625068
15.00	-.00007421	-.02148216	-.00288284	-.01081491
20.00	-.00004383	-.01619398	-.00162027	-.00807034

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 8.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00212182	-16.295922	-3310.9181	-18.580823
00.02	-.00212168	-8.1479418	-827.72805	-9.2904248
00.03	-.00212145	-5.4319400	-367.87805	-6.1936314
00.04	-.00212112	-4.0739327	-206.93055	-4.6452391
00.06	-.00212018	-2.7159127	-91.968051	-3.0968557
00.08	-.00211887	-2.0368900	-51.731177	-2.3226728
00.10	-.00211718	-1.6294663	-33.107253	-1.8581702
00.15	-.00211134	-1.0862051	-14.713256	-1.2388540
00.20	-.00210316	-.81454310	-8.2753615	-.92921782
00.25	-.00209268	-.65152105	-5.2955400	-.74345355
00.30	-.00207990	-.54281925	-3.6768759	-.61962506
00.35	-.00206485	-.46515788	-2.7008770	-.53118827
00.40	-.00204756	-.40689708	-2.0674209	-.46487112
00.50	-.00200635	-.32529764	-1.3224895	-.37205151
00.60	-.00195654	-.27086173	-.91785239	-.31019781
00.70	-.00189849	-.23195007	-.67388643	-.26603761
00.80	-.00183256	-.20274331	-.51556076	-.23293454
00.90	-.00175922	-.18000875	-.40703081	-.20720156
01.00	-.00167893	-.16180694	-.32941743	-.18662635
01.20	-.00149972	-.13447698	-.22836287	-.15578669
01.40	-.00129965	-.11493699	-.16748864	-.13377740
01.60	-.00108394	-.10027967	-.12803413	-.11727882
01.80	-.00085816	-.08889010	-.10103513	-.10444646
02.00	-.00062803	-.07979909	-.08176863	-.09417370
02.20	-.00039928	-.07238916	-.06755365	-.08575664
02.40	-.00017748	-.06624765	-.05677602	-.07872654
02.60	.00003214	-.06108763	-.04841635	-.07275952
02.80	.00022482	-.05670271	-.04180496	-.06762498
03.00	.00039643	-.05294008	-.03648705	-.06315462
03.50	.00071271	-.04555579	-.02698174	-.05413387
04.00	.00084748	-.04016755	-.02080407	-.04727703
04.50	.00080421	-.03605103	-.01651786	-.04188961
05.00	.00061721	-.03275233	-.01338261	-.03756687
07.50	-.00044679	-.02166157	-.00562615	-.02510735
10.00	.00019453	-.01592726	-.00337881	-.01898278
15.00	-.00010111	-.01065718	-.00140922	-.01263680
20.00	-.00006866	-.00811917	-.00078639	-.00941400

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 8.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.00177938	-28.826374	-5837.3411	-14.052868
00.02	-.00177929	-14.413174	-1459.3341	-7.0264429
00.03	-.00177914	-9.6087676	-648.59211	-4.6843053
00.04	-.00177893	-7.2065602	-364.83241	-3.5132395
00.06	-.00177834	-4.8043438	-162.14690	-2.3421798
00.08	-.00177750	-3.6032267	-91.206974	-1.7566559
00.10	-.00177643	-2.8825494	-58.371922	-1.4053464
00.15	-.00177272	-1.9216257	-25.942244	-.93694766
00.20	-.00176753	-1.4411418	-14.591859	-.70276322
00.25	-.00176087	-1.1528341	-9.3382543	-.56226440
00.30	-.00175276	-.96061454	-6.4844473	-.46860829
00.35	-.00174319	-.82330274	-4.7636946	-.40171934
00.40	-.00173219	-.72030846	-3.6468628	-.35155976
00.50	-.00170597	-.57609208	-2.3334767	-.28135310
00.60	-.00167425	-.47992186	-1.6200431	-.23456661
00.70	-.00163722	-.41120792	-1.1898762	-.20116231
00.80	-.00159511	-.35965551	-.91069232	-.17612110
00.90	-.00154816	-.31954548	-.71929592	-.15665449
01.00	-.00149666	-.28744645	-.58240225	-.14108933
01.20	-.00138127	-.23927534	-.40411014	-.11775902
01.40	-.00125166	-.20484926	-.29664301	-.10111000
01.60	-.00111086	-.17902238	-.22692836	-.08863175
01.80	-.00096211	-.15893614	-.17916544	-.07892938
02.00	-.00080879	-.14287535	-.14503122	-.07116595
02.20	-.00065429	-.12974822	-.11980283	-.06480898
02.40	-.00050194	-.11882638	-.10063815	-.05950375
02.60	-.00035491	-.10960489	-.08574352	-.05500502
02.80	-.00021613	-.10172234	-.07394146	-.05113800
03.00	-.00008822	-.09491288	-.06443302	-.04777495
03.50	.00017041	-.08138062	-.04741475	-.04100117
04.00	.00032586	-.07133110	-.03638111	-.03586269
04.50	.00037457	-.06357567	-.02879997	-.03182623
05.00	.00033077	-.05738801	-.02334539	-.02857967
07.50	-.00020255	-.03827759	-.01021798	-.01905219
10.00	.00007865	-.02851743	-.00583945	-.01438375
15.00	-.00005668	-.01903906	-.00255008	-.00957788
20.00	-.00003896	-.01434527	-.00143069	-.00715080

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 9.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00148281	-14.413183	-2918.6699	-16.515121
00.02	-.00148271	-7.2065780	-729.66646	-8.2575700
00.03	-.00148254	-4.8043705	-324.29545	-5.5050570
00.04	-.00148232	-3.6032623	-182.41560	-4.1288035
00.06	-.00148166	-2.4021452	-81.072846	-2.7525563
00.08	-.00148075	-1.8015778	-45.602883	-2.0644388
00.10	-.00147957	-1.4412303	-29.185358	-1.6515733
00.15	-.00147549	-.96074627	-12.970520	-1.1011002
00.20	-.00146978	-.72048233	-7.2953295	-.82587899
00.25	-.00146246	-.57630660	-4.6685298	-.66075836
00.30	-.00145354	-.48017516	-3.2416294	-.55068793
00.35	-.00144303	-.41149780	-2.3812565	-.47207464
00.40	-.00143095	-.35997946	-1.8228447	-.41312193
00.50	-.00140217	-.28782979	-1.1661615	-.33060513
00.60	-.00136739	-.23970465	-.80945648	-.27561204
00.70	-.00132684	-.20530936	-.59438675	-.23634590
00.80	-.00128080	-.17949680	-.45481047	-.20690817
00.90	-.00122957	-.15940763	-.35912969	-.18402182
01.00	-.00117348	-.14332639	-.29070193	-.16572051
01.20	-.00104828	-.11918543	-.20159851	-.13828469
01.40	-.00090847	-.10192884	-.14791266	-.11870095
01.60	-.00075769	-.08898470	-.11310690	-.10401902
01.80	-.00059982	-.07892437	-.08927962	-.09259968
02.00	-.00043886	-.07089050	-.07226796	-.08345944
02.20	-.00027881	-.06433699	-.05970917	-.07597268
02.40	-.00012355	-.05889911	-.05018091	-.06972267
02.60	.00002326	-.05432345	-.04278513	-.06442132
02.80	.00015828	-.05042804	-.03693199	-.05986341
03.00	.00027860	-.04707839	-.03222104	-.05589897
03.50	.00050066	-.04047805	-.02379503	-.04791419
04.00	.00059560	-.03563338	-.01832048	-.04186170
04.50	.00056549	-.03191800	-.01453161	-.03711604
05.00	.00043402	-.02894231	-.01177277	-.03331036
07.50	-.00031952	-.01917071	-.00500433	-.02225196
10.00	.00014332	-.01414961	-.00296953	-.01679772
15.00	-.00007687	-.00945353	-.00125074	-.01118908
20.00	-.00006072	-.00719052	-.00069455	-.00834151

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 9 0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.00129256	-25.851587	-5222.5431	-12.664674
00.02	-.00129249	-12.925784	-1305.6350	-6.3323436
00.03	-.00129239	-8.6171785	-580.28160	-4.2215696
00.04	-.00129223	-6.4628726	-326.40792	-3.1661849
00.06	-.00129180	-4.3085602	-145.06958	-2.1108045
00.08	-.00129120	-3.2313975	-81.601164	-1.5831186
00.10	-.00129042	-2.5850948	-52.224353	-1.2665106
00.15	-.00128773	-1.7233428	-23.210220	-.84437665
00.20	-.00128396	-1.2924509	-13.055276	-.63332049
00.25	-.00127912	-1.0339030	-8.3549887	-.50669538
00.30	-.00127323	-.86152737	-5.8017484	-.42228571
00.35	-.00126629	-.73839308	-4.2622272	-.36199908
00.40	-.00125830	-.64603478	-3.2630208	-.31678928
00.50	-.00123927	-.51671546	-2.0879599	-.25350768
00.60	-.00121624	-.43048370	-1.4496630	-.21133296
00.70	-.00118935	-.36887438	-1.0647980	-.18121875
00.80	-.00115877	-.32265508	-.81501386	-.15864180
00.90	-.00112468	-.28669676	-.64377072	-.14108911
01.00	-.00108728	-.25792210	-.52128951	-.12705285
01.20	-.00100348	-.21474370	-.36176327	-.10601110
01.40	-.00090933	-.18388878	-.26560107	-.09099251
01.60	-.00080705	-.16074224	-.20321392	-.07973475
01.80	-.00069897	-.14274032	-.16046557	-.07098086
02.00	-.00058755	-.12834472	-.12990990	-.06397665
02.20	-.00047524	-.11657631	-.10732178	-.05824226
02.40	-.00036446	-.10678196	-.09015877	-.05345800
02.60	-.00025752	-.09850902	-.07681641	-.04940275
02.80	-.00015655	-.09143362	-.06624156	-.04591888
03.00	-.00006346	-.08531768	-.05771963	-.04289109
03.50	.00012488	-.07314892	-.04246175	-.03680089
04.00	.00023819	-.06409507	-.03256745	-.03219097
04.50	.00027374	-.05709773	-.02577195	-.02857644
05.00	.00024172	-.05151221	-.02088797	-.02567209
07.50	-.00014983	-.03435469	-.00916769	-.01711426
10.00	.00005952	-.02562473	-.00522524	-.01290556
15.00	-.00004379	-.01710097	-.00228775	-.00859658
20.00	-.00003312	-.01287832	-.00128249	-.00642150

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 10.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00107713	-12.925790	-2611.2711	-14.862495
00.02	-.00107706	-6.4628855	-652.81704	-7.4312541
00.03	-.00107694	-4.3085796	-290.14036	-4.9541769
00.04	-.00107677	-3.2314234	-163.20352	-3.7156405
00.06	-.00107630	-2.1542607	-72.534354	-2.4771086
00.08	-.00107563	-1.6156729	-40.800145	-1.8578471
00.10	-.00107478	-1.2925151	-26.111740	-1.4862938
00.15	-.00107181	-.86162306	-11.604675	-.99089971
00.20	-.00106767	-.64616109	-6.5272036	-.74321375
00.25	-.00106235	-.51687129	-4.1770620	-.59461095
00.30	-.00105588	-.43066771	-2.9004440	-.49554965
00.35	-.00104825	-.36908498	-2.1306860	-.42479769
00.40	-.00103948	-.32289043	-1.6310857	-.37173898
00.50	-.00101858	-.25820063	-1.0435624	-.29746909
00.60	-.00099333	-.21505567	-.72442244	-.24796895
00.70	-.00096389	-.18422317	-.53199991	-.21262231
00.80	-.00093046	-.16108710	-.40711917	-.18612093
00.90	-.00089325	-.14308312	-.32151020	-.16551575
01.00	-.00085253	-.12867273	-.26028340	-.14903724
01.20	-.00076159	-.10704325	-.18055115	-.12433116
01.40	-.00066004	-.09158410	-.13250459	-.10669360
01.60	-.00055049	-.07998849	-.10134837	-.09346970
01.80	-.00043578	-.07097498	-.08001342	-.08318441
02.00	-.00031878	-.06377460	-.06477576	-.07495275
02.20	-.00020241	-.05789765	-.05352184	-.06821168
02.40	-.00008949	-.05301717	-.04497953	-.06258613
02.60	.00001731	-.04890617	-.03834571	-.05781672
02.80	.00011558	-.04540179	-.03309301	-.05371857
03.00	.00020319	-.04238385	-.02886344	-.05015651
03.50	.00036503	-.03642011	-.02129483	-.04299178
04.00	.00043439	-.03202440	-.01637838	-.03757177
04.50	.00041259	-.02864418	-.01298185	-.03332836
05.00	.00031667	-.02593778	-.01051685	-.02992688
07.50	-.00023593	-.01720006	-.00450685	-.01998460
10.00	.00010804	-.01273119	-.00265003	-.01506869
15.00	-.00005919	-.00849848	-.00112525	-.01004089
20.00	-.00005147	-.00645347	-.00062371	-.00749091

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 10.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.00096857	-23.439780	-4727.0224	-11.524564
00.02	-.00096852	-11.719883	-1181.7550	-5.7622869
00.03	-.00096844	-7.8132470	-525.22399	-3.8415300
00.04	-.00096833	-5.8599268	-295.43814	-2.8811532
00.06	-.00096800	-3.9066017	-131.30539	-1.9207797
00.08	-.00096755	-2.9299343	-73.858923	-1.4405962
00.10	-.00096697	-2.3439301	-47.269418	-1.1524887
00.15	-.00096495	-1.5625798	-21.008179	-.76835290
00.20	-.00096213	-1.1718927	-11.816747	-.57629310
00.25	-.00095851	-.93747094	-7.5624280	-.46106362
00.30	-.00095409	-.78118196	-5.2514416	-.38424927
00.35	-.00094889	-.66954036	-3.8579912	-.32938635
00.40	-.00094291	-.58580348	-2.9535899	-.28824303
00.50	-.00092865	-.46855858	-1.8900183	-.23065144
00.60	-.00091140	-.39038117	-1.3122815	-.19226678
00.70	-.00089126	-.33452876	-.96393037	-.16485709
00.80	-.00086835	-.29263022	-.73784309	-.14430633
00.90	-.00084281	-.26003499	-.58284441	-.12832776
01.00	-.00081480	-.23395281	-.47198075	-.11554931
01.20	-.00075201	-.19481723	-.32758243	-.09639111
01.40	-.00068147	-.16685332	-.24053505	-.08271507
01.60	-.00060482	-.14587637	-.18405726	-.07246269
01.80	-.00052381	-.12956166	-.14535428	-.06449022
02.00	-.00044029	-.11651433	-.11768670	-.05811143
02.20	-.00035609	-.10584658	-.09723051	-.05288969
02.40	-.00027302	-.09696627	-.08168470	-.04853404
02.60	-.00019281	-.08946309	-.06959726	-.04484324
02.80	-.00011706	-.08304358	-.06001516	-.04167375
03.00	-.00004721	-.07749205	-.05229180	-.03892055
03.50	.00009418	-.06643639	-.03846011	-.03338822
04.00	.00017931	-.05819932	-.02948932	-.02920727
04.50	.00020604	-.05182627	-.02332998	-.02593362
05.00	.00018193	-.04673721	-.01890682	-.02330512
07.50	-.00011379	-.03116774	-.00831551	-.01553651
10.00	.00004595	-.02326841	-.00472970	-.01170538
15.00	-.00003431	-.01552437	-.00207519	-.00779888
20.00	-.00002771	-.01168540	-.00116301	-.00582842

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 11.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00080714	-11.719887	-2363.5109	-13.510435
00.02	-.00080708	-5.8599365	-590.87717	-6.7552224
00.03	-.00080700	-3.9066162	-262.61167	-4.5034872
00.04	-.00080687	-2.9299537	-147.71874	-3.3776212
00.06	-.00080652	-1.9532863	-65.652366	-2.2517586
00.08	-.00080602	-1.4649478	-36.929135	-1.6888307
00.10	-.00080538	-1.1719408	-23.634383	-1.3510766
00.15	-.00080316	-.78125367	-10.503764	-.90074553
00.20	-.00080005	-.58589813	-5.9080489	-.67558828
00.25	-.00079607	-.46867536	-3.7808909	-.54050049
00.30	-.00079122	-.39051906	-2.6253993	-.45044737
00.35	-.00078551	-.33468659	-1.9286760	-.38612828
00.40	-.00077894	-.29280660	-1.4764776	-.33789290
00.50	-.00076329	-.23416157	-.94469705	-.27037257
00.60	-.00074437	-.19505106	-.65583503	-.22536882
00.70	-.00072232	-.16710399	-.48166691	-.19323121
00.80	-.00069727	-.14613492	-.36863173	-.16913444
00.90	-.00066940	-.12981870	-.29114181	-.15039774
01.00	-.00063889	-.11676032	-.23572030	-.13541260
01.20	-.00057076	-.09716233	-.16354421	-.11294363
01.40	-.00049466	-.08315661	-.12004634	-.09690159
01.60	-.00041256	-.07265136	-.09183537	-.08487325
01.80	-.00032658	-.06448457	-.07251321	-.07551786
02.00	-.00023887	-.05795894	-.05870946	-.06803099
02.20	-.00015161	-.05263048	-.04851139	-.06190084
02.40	-.00006692	-.04820282	-.04076781	-.05678639
02.60	.00001321	-.04447030	-.03475204	-.05245181
02.80	.00008695	-.04128551	-.02998698	-.04872892
03.00	.00015271	-.03853976	-.02614880	-.04549467
03.50	.00027428	-.03310244	-.01927813	-.03899575
04.00	.00032648	-.02908245	-.01481574	-.03408672
04.50	.00031017	-.02598498	-.01173698	-.03024764
05.00	.00023808	-.02350547	-.00950811	-.02717128
07.50	-.00017894	-.01560064	-.00409951	-.01813952
10.00	.00008318	-.01157230	-.00239358	-.01366546
15.00	-.00004627	-.00772087	-.00102309	-.00910776
20.00	-.00004297	-.00585418	-.00056692	-.00679917

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Moment, M = 11.0

Ω	$\bar{C}_{Lh}$	C^*_{Lh}	$\bar{C}_{L\alpha}$	$C^*_{L\alpha}$
00.01	-.00074456	-21.443638	-4318.7189	-10.571868
00.02	-.00074452	-10.721814	-1079.6793	-5.2859378
00.03	-.00074446	-7.1478695	-479.85710	-3.5239627
00.04	-.00074437	-5.3608956	-269.91934	-2.6429764
00.06	-.00074412	-3.5739180	-119.96381	-1.7619926
00.08	-.00074378	-2.6804255	-67.479367	-1.3215032
00.10	-.00074333	-2.1443270	-43.186570	-1.0572116
00.15	-.00074178	-1.4295204	-19.193685	-.70482853
00.20	-.00073961	-1.0721079	-10.796176	-.52864321
00.25	-.00073683	-.85765310	-6.9093303	-.42293693
00.30	-.00073343	-.71467722	-4.7979583	-.35247015
00.35	-.00072944	-.61254652	-3.5248688	-.30214017
00.40	-.00072484	-.53594412	-2.6985860	-.26439565
00.50	-.00071388	-.42869057	-1.7268807	-.21156028
00.60	-.00070063	-.35717732	-1.1990453	-.17634417
00.70	-.00068515	-.30608767	-.88078169	-.15119588
00.80	-.00066754	-.26776332	-.67422100	-.13233966
00.90	-.00064791	-.23794976	-.53260828	-.11767783
01.00	-.00062638	-.21409429	-.43131813	-.10595175
01.20	-.00057812	-.17830161	-.29938679	-.08836989
01.40	-.00052390	-.15272778	-.21985191	-.07581787
01.60	-.00046497	-.13354431	-.16824552	-.06640742
01.80	-.00040269	-.11862435	-.13287818	-.05908943
02.00	-.00033847	-.10669180	-.10759274	-.05323441
02.20	-.00027372	-.09693443	-.08889566	-.04844184
02.40	-.00020982	-.08881058	-.07468483	-.04444482
02.60	-.00014812	-.08194497	-.06363380	-.04105870
02.80	-.00008984	-.07606920	-.05487199	-.03815174
03.00	-.00003609	-.07098615	-.04780879	-.03562753
03.50	.00007275	-.06085655	-.03515688	-.03055917
04.00	.00013832	-.05330147	-.02695032	-.02673354
04.50	.00015892	-.04745121	-.02131701	-.02374125
05.00	.00014032	-.04277829	-.01727412	-.02134003
07.50	-.00008836	-.02852607	-.00760969	-.01422657
10.00	.00003612	-.02131109	-.00432116	-.01071104
15.00	-.00002727	-.01421593	-.00189926	-.00713747
20.00	-.00002308	-.01069596	-.00106440	-.00533637

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Continued), Lift, M = 12.0

Ω	$\bar{C}_{Mh}$	C^*_{Mh}	$\bar{C}_{M\alpha}$	$C^*_{M\alpha}$
00.01	-.00062046	-10.721817	-2159.3592	-12.383831
00.02	-.00062042	-5.3609031	-539.83938	-6.1919193
00.03	-.00062035	-3.5739292	-239.92830	-4.1279505
00.04	-.00062026	-2.6804404	-134.95942	-3.0959673
00.06	-.00061998	-1.7869478	-59.981652	-2.0639868
00.08	-.00061960	-1.3401979	-33.739433	-1.5479991
00.10	-.00061911	-1.0721449	-21.593035	-1.2384085
00.15	-.00061740	-.71473235	-9.5965928	-.82562700
00.20	-.00061502	-.53601689	-5.3978391	-.61924260
00.25	-.00061196	-.42878034	-3.4544172	-.49541700
00.30	-.00060823	-.35728333	-2.3987325	-.41287075
00.35	-.00060384	-.30620900	-1.7621892	-.35391265
00.40	-.00059879	-.26789893	-1.3490495	-.30969709
00.50	-.00058676	-.21425479	-.86320092	-.24780237
00.60	-.00057223	-.17848140	-.59928809	-.20654675
00.70	-.00055528	-.15292053	-.44016201	-.17708453
00.80	-.00053603	-.13374314	-.33688815	-.15499281
00.90	-.00051461	-.11882205	-.26608902	-.13781437
01.00	-.00049116	-.10688102	-.21545186	-.12407486
01.20	-.00043879	-.08896145	-.14950390	-.10347231
01.40	-.00038029	-.07615626	-.10975626	-.08876175
01.60	-.00031718	-.06655161	-.08397450	-.07773129
01.80	-.00025107	-.05908436	-.06631334	-.06915203
02.00	-.00018362	-.05311656	-.05369368	-.06228666
02.20	-.00011651	-.04824202	-.04436818	-.05666607
02.40	-.00005136	-.04418969	-.03728527	-.05197765
02.60	.00001029	-.04077153	-.03178123	-.04800518
02.80	.00006703	-.03785284	-.02742028	-.04459441
03.00	.00011766	-.03533440	-.02390673	-.04163246
03.50	.00021128	-.03033924	-.01761549	-.03568519
04.00	.00025154	-.02663758	-.01352989	-.03119793
04.50	.00023903	-.02378108	-.01071393	-.02769171
05.00	.00018347	-.02149478	-.00867917	-.02488277
07.50	-.00013881	-.01427576	-.00375976	-.01660819
10.00	.00006526	-.01060733	-.00218308	-.01250330
15.00	-.00003671	-.00707479	-.00093815	-.00833426
20.00	-.00003575	-.00535726	-.00052010	-.00622525

Table 1208.2 AERODYNAMIC FLUTTER COEFFICIENTS (Concluded), Moment, M = 12.0

SECTION 12 - AEROELASTIC PHENOMENA

REFERENCES

(Note: In this list APL/JHU designates the Applied Physics Laboratory of The Johns Hopkins University, and NACA designates the National Advisory Committee for Aeronautics.)

Ref. No.	Title
12-1	von Borbely, S.: "Concerning the Airforces Which Act on a Two-Dimensional Oscillating Airfoil Moving at Supersonic Speed," Z. Agnew. Math. Mech., Volume 22, No. 4, August 1942, pages 190-205. Translations: Chance-Vought Report 5339, April 13, 1945; British Ministry of Aircraft Production, RTP Translation 2019.
12-2	Smilg, Benjamin and Wasserman, Lee S.: "Application of Three-Dimensional Flutter Theory to Aircraft Structures," Army Air Corps Technical Report 4798, July 9, 1942.
12-3	Flax, A. H.: "Aeroelastic Problems at Supersonic Speeds," "SECOND INTERNATIONAL AERONAUTICAL CONFERENCE, MAY 24-27, 1949; CONVENED BY INSTITUTE OF AERONAUTICAL SCIENCES AND ROYAL AERONAUTICAL SOCIETY." Editor, Berneice H. Jarck, Institute of Aeronautical Sciences, Inc., New York, pages 322-360.
12-4	Garrick, I. E. and Rubinow, S. I.: "Theoretical Study of Air Forces on an Oscillating or Steady Thin Wing in a Supersonic Main Stream," NACA Technical Note 1383, 1947.
12-5	Miles, John W.: "The Oscillating Rectangular Airfoil at Supersonic Speeds," NAVORD Report 1170, July 21, 1949.
12-6	Miles, John W.: "On Harmonic Motion of Delta Airfoils at Supersonic Speeds," NAVORD Report 1234, June 13, 1950.
12-7	Watkins, Charles E.: "Effect of Aspect Ratio on the Air Forces and Moments of Harmonically Oscillating Thin Rectangular Wings in Supersonic Potential Flow," NACA Technical Note 2064, April 1950.
12-8	Flax, A. H. and Sherman, S.: "Ground Vibration Tests as a Basis for Flutter Analyses," Curtiss-Wright Report SD-145-S-2, July 30, 1943.
12-9	Garrick, I. E. and Rubinow, S. I.: "Flutter and Oscillating Airforce Calculations for an Airfoil in a Two-Dimensional Supersonic Flow," NACA Report 846 or Technical Note 1158, October 1946.
12-10	Barton, M. V.: "Stability of an Oscillating Airfoil in Supersonic Flow," Journal of the Aeronautical Sciences, Volume 15, No. 6, June 1948, page 371.
12-11	Cheilek, H. and Frissel, H.: "Theoretical Criteria for Single Degree of Freedom Flutter at Supersonic Speeds," Cornell Aeronautical Laboratory Report CAL-7A, May 8, 1947.

12-12 Loring; S. J.: "General Approach to the Flutter Problem," Society of Automotive Engineers Journal, Volume 49, No. 2, August 1941, pages 345-355.

12-13 Loring, S. J.: "Use of Generalized Coordinates in Flutter Analysis," Society of Automotive Engineers Journal, Volume 52, No. 4 (Transactions Section), April 1944, pages 113-132.

12-14 Keller, E. G., Black, S. D., Czuba, T., and Pengelley, C. D.: "Supersonic Airforce Coefficients for Flutter Analysis," Curtiss-Wright Report P537-V-28, APL/JHU Report CM-469, April 22, 1948.

12-15 Possio, C.: "L'Azione Aerodinamica sul Profilo Oscillante alle Velocita Ultrasonore," Acta. Pont. Acad. Sci., Volume I, No. 11, 1937, pages 93-106.

12-16 Barton, M. V. and Poindexter, A. M.: "The Effect of the Variation of Some Structural Parameters on Binary Flutter in a Supersonic Flow," University of Texas Report UT/DRL-150, APL/JHU Report CM-417, March 1, 1946.

12-17 Ruggiero, R. J.: "Investigation of Three Methods of Solving the Flutter Equations and Their Respective Merits," Journal of the Aeronautical Sciences, Volume 13, No. 1, January 1946, pages 3-22.

The following bibliography is suggested for additional information on the subjects covered in this section:

12-18 Anderson, R. A.: "Determination of Coupled Modes and Frequencies of Swept Wings by Use of Power Series," NACA Report RM L7H28, October 20, 1947.

12-19 Anderson, R. A. and Houbolt, J. C.: "Determination of Coupled and Uncoupled Modes and Frequencies of Natural Vibration of Swept and Unswept Wings from Uniform Cantilever Modes," NACA Technical Note 1747, November 1948.

12-20 Army Air Forces: "The Effect of Sweepback on the Critical Flutter Speed of Wings," Report TSEAC 5-4595-2-5, March 1946.

12-21 Army Air Forces: "The Effect of Sweepforward on the Critical Flutter Speed of Wings," Report TSEAC 5-4595-2-6, April 1946.

12-22 Army Air Forces: "German Experience with Aileron Compressibility Flutter," Report TSEAC 5-4595-2-11, May 1946.

12-23 Arnold, L.: "Vector Solution of the Three-Degree Case of Wing Bending, Wing Torsion, Aileron Flutter," Journal of Aeronautical Sciences, Volume 9, No. 13, November 1942, pages 497-500.

12-24 Bairstow, L.: "The Theory of Wing Flutter," Aeronautical Research Committee Report R and M 1041, 1927.

12-25 Barton, M. V.: "Stability of Supersonic Airflow on an Oscillating Airfoil," University of Texas Report UT/DRL-127, APL/JHU Report CF-753, August 13, 1947.

12-26 Barton, M. V.: "Two-Dimensional Torsional Flutter at Supersonic Speed," University of Texas Report UT/DRL-130, APL/JHU Report CF-761, August 26, 1947.

12-27 Barton, M. V.: "Coefficient Method for Solving the Flutter Frequency Equation," Journal of the Aeronautical Sciences, Volume 12, No. 2, pages 164-168, April 1945.

12-28 Barton, M. V. and Poindexter, A. M.: "Values of Some Aerodynamic Parameters Useful for Supersonic Flutter Studies," University of Texas Report UT/DRL-125, APL/JHU Report CF-720, July 10, 1947.

12-29 Bell, W. D.: "A Simplified Punch-Card Approach to the Solution of the Flutter Determinant," Journal of the Aeronautical Sciences, Volume 15, No. 2, February 1948, pages 121-122.

12-30 Bergen, W. B. and Arnold, L.: "Graphical Solution of the Bending-Aileron Case of Flutter," Journal of the Aeronautical Sciences, Volume 7, No. 12, October 1940, page 495.

12-31 Biot, M. A.: "Three-Dimensional Aerodynamic Theory Applied to Flutter Analysis," California Institute of Technology Report GALCIT-6, December 1, 1942.

12-32 Biot, M. A.: "Aero-Elastic Stability of Supersonic Wings, Report No. I: Chordwise Divergence, the Two-Dimensional Case," Cornell Aeronautical Laboratory Report CAL-1-E-1, APL/JHU Report CM-427, December 8, 1947.

12-33 Biot, M. A.: "Aero-Elastic Stability of Supersonic Wings, Report No. 2: An Approximate Treatment of Some Simple Three-Dimensional Cases," Cornell Aeronautical Laboratory Report CAL-1-E-1, APL/JHU Report CM-470, May 12, 1948.

12-34 Biot, M. A. and Wiancko, T. H.: "Theory of Electrical Flutter Predictor for Three Degrees of Freedom," California Institute of Technology Report GALCIT-8, January 1943.

12-35 Biot, M. A. and Wiancko, T. H.: "Electrical Network Model for Flexure-Torsion Flutter," California Institute of Technology Report GALCIT-3, September 1941.

12-36 Bleakney, W. M.: "Three-Dimensional Flutter Analysis," Journal of the Aeronautical Sciences, Volume 9, No. 2, December 1941, pages 56-63.

12-37 Bleakney, W. M. and Hamm, J. D.: "Vector Methods of Flutter Analysis," Journal of the Aeronautical Sciences, Volume 9, No. 12, October 1942, pages 439-451.

12-38 Bureau of Aeronautics: "A Vector Solution of the Flutter Stability Determinant," NAVAER Report SM-26, May 22, 1944.

12-39 Buxton, G. H. L. and Minhinnick, I. T.: "Expressions for the Rates of Change of Critical Flutter Speeds and Frequencies with Inertial, Aerodynamic and Elastic Coefficients," Royal Aircraft Establishment Report SME 3339.

12-40 Cicala, P.: "Comparison of Theory with Experiment in the Phenomenon of Wing Flutter," NACA Technical Memorandum 887, February 1939.

12-41 Collar, A. R.: "Resistance Derivatives of Flutter Theory. Part II: Results for Supersonic Speeds," Aeronautical Research Council Report R and M 2139 (7470), January 1944; Royal Aircraft Establishment Report SME 3278.

12-42 Collar, A. R.: "The Expanding Domain of Aeroelasticity," Journal of the Royal Aeronautical Society, Volume 50, No. 428, August 1946, pages 613-636.

12-43 Collar, A. R.: "Aeroelastic Problems at High Speed," Journal of the Royal Aeronautical Society, Volume 51, No. 433, January 1947, pages 1-34.

12-44 Curtiss-Wright Corporation: "Structural Damping Coefficient in Flutter Calculations," Report 8458, August 18, 1941.

12-45 DiPaola, J.: "Arnold's Vector Method for Solving the Flutter Stability Determinant," Curtiss-Wright Report V-241-S-3, July 14, 1944.

12-46 Duncan, W. J.: "The Fundamentals of Flutter," Royal Aircraft Establishment Report Aero 1920, March 1944.

12-47 Duncan, W. J. and Collar, A. R.: "Calculation of the Resistance Derivatives of Flutter Theory," Aeronautical Research Committee Report R and M 1500, 1932.

12-48 Durling, B. J. and Huckel, V.: "Tables of Wing-Aileron Coefficients of Oscillating Air Forces for Two-Dimensional Supersonic Flow," NACA Technical Note 2055, March 1950.

12-49 Flax, A. H.: "Three-Dimensional Wing Flutter Analysis," Journal of the Aeronautical Sciences, Volume 10, No. 2, February 1943, pages 41-47.

12-50 Garrick, I. E.: "A Survey of Flutter," NACA University Conference on Aerodynamics - A Compilation of the Papers Presented at Langley Aeronautical Laboratory, Langley Field, Virginia, June 21-23, 1948, pages 289-304.

12-51 Jahn, H. A.: "A Review of British Work on Aerodynamic Derivatives for Flutter Prediction," Royal Aircraft Establishment Report SME 275, September 1944.

12-52 Jordan, P.: "Instationare Luftkrafte Beiwerte Bei Uberschall (Non-Stationary Air Force Coefficients at Supersonic Speed)," Aerodynamische Vesuchsanstalt Gottingen E. V. Institut fur Jastationare Vorgange J06, B45/J/8. Curtiss-Wright Translation U-46-14, August 23, 1946; Cornell Aeronautical Laboratory Translation by Jack Lotsof, May 1947.

12-53 Karp, S. N. and Weil, H.: "The Oscillating Airfoil in Compressible Flow," Air Materiel Command Report F-TR-1195-ND, Monograph III, Part II, June 1948.

12-54 Katz, H.: "Resume of Flutter Model Investigations," Bureau of Aeronautics Project Report 9.

12-55 Katz, H.: "Solution of the Stability Determinant," Bureau of Aeronautics Structures Memorandum 13.

12-56 Kussner, H. G.: "Status of Wing Flutter," NACA Technical Memorandum 872, January 1936.

12-57 Leppert, E. L., Jr.: "An Application of IBM Machines to the Solution of the Flutter Determinant," Journal of the Aeronautical Sciences, Volume 14, No. 3, March 1947, pages 171-174.

12-58 Miles, J. W.: "The Aerodynamic Forces on an Oscillating Airfoil at Supersonic Speeds," Journal of the Aeronautical Sciences, Volume 14, No. 6, June 1947, pages 351-358.

12-59 Pinkel, I. I.: "A Comparative Study of the Effect of Wing Flutter Shape on the Critical Flutter Speed," NACA Report ARR 3K15, November 1943.

12-60 Porter, F. P.: "A Simple Method for the Calculation of Natural Frequencies in Torsional Vibration," American Society of Mechanical Engineers Paper OGP-53-2, 1931.

12-61 Pugsley, A. G.: "A Simplified Theory of Wing Flutter," Aeronautical Research Committee Report R and M 1839, 1938.

12-62 Reissner, E. and Sherman, S.: "Compressibility Effects in Flutter," Curtiss-Wright Report SB-240-S-1, January 1944.

12-63 Scanlan, R. H. and Rosenbaum, R.: "INTRODUCTION TO THE STUDY OF AIRCRAFT VIBRATION AND FLUTTER," Macmillan, 1951.

12-64 Sezawa, K.: "The Nature of Wing Flutter as Revealed Through its Vibrational Frequencies," Journal of the Aeronautical Sciences, Volume 4, No. 1, 1936, pages 30-34.

12-65 Sezawa, K. and Kubo, S.: "The Nature of the Torsion-Aileron Flutter of a Wing as Revealed by Analytical Experiments," Tokyo Report 136, Volume 11, 1936, page 107.

12-66 Sherman, S., DiPaola, J. and Frissel, H. F.: "The Simplification of Flutter Calculations by Use of an Extended Form of the Routh-Hurwitz Discriminant," Journal of the Aeronautical Sciences, Volume 12, No. 4, October 1945, pages 385-392.

12-67 Targoff, W. P.: "The Associate Matrices of Bending and Coupled Bending-Torsion Vibrations," Journal of the Aeronautical Sciences, Volume 14, No. 10, October 1947, pages 579-582.

12-68 Teichmann, A.: "State and Development of Flutter Calculation," NACA Technical Note 1297, March 1951.

12-69 Theodorsen, T.: "General Theory of Aerodynamic Instability and the Mechanism of Flutter," NACA Report 496, 1935.

12-70 Theodorsen, T. and Garrick, I. E.: "Mechanism of Flutter - A Theoretical and Experimental Investigation of the Flutter Problem," NACA Report 685, 1940.

12-71 Theodorsen, T. and Garrick, I. E.: "Flutter Calculations in Three Degrees of Freedom," NACA Report 741, 1942.

12-72 Voigt, H.: "Wind Tunnel Investigations on Flexural-Torsional Wing Flutter," NACA Technical Memorandum 877, September 1938.

12-73 Williams, J.: "Methods of Predicting Flexure-Torsion Flutter," Aeronautical Research Committee Report 6574, March 20, 1943.

12-74 Wylie, J.: "Flexure-Torsion Binary Flutter," Civil Aeronautics Authority, Department of Commerce Report 22, 1941.

12-75 Zahm, A. F. and Bear, R. M.: "A Study of Wing Flutter," NACA Report 285, 1928.

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